ARMOURERS' WING
PRECIS

VOLUME III

REME TECHNICAL TRAINING SCHOOL BAOR

ARMOURERS' WING PRECIS

VOLUME III

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R.E.M.E. TECHNICAL TRAINING SCHOOL

B.A.O.R.

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GUNS, MACHINE BESA 7.92 m.m

GENERAL INFORMATION

The following Marks of BESA may be met in the Service:—

Mk 1. The original Czech design made in Czechoslovakia.

Mk 2. The BSA production model.

Mk 2*. The transitional pattern between Mks 2 and 3.

Mk 3. The Mk 3 has a fixed high rate of fire.

Mk 3*. The Mk 3* has a fixed low rate of fire.

The 7.92 mm. Besa MG is intended for mounting in AFVs, it has no ground mounting or sights, and aiming is carried out by means of a Sighting Telescope housed in the Gun Mounting. It is an air-cooled, gas operated weapon with buffered action, ammunition being fed by a belt holding 225 rounds. The Barrel cannot be changed unless the Gun is removed from the Mounting. The Gun may be fired dismounted, provided the ejection opening is clear of the ground.

Weight of Gun . . .	Mk 2, 47 lbs., Mk 3, 54 lbs.
Weight of Barrel	15 lbs.
Overall Length of Gun . . .	3' 7½".
Length of Barrel	2' 5"
Rifling	4 grooves, Right Hand, 1 turn in 10".

Rate of Fire (Rounds per Minute)

Mk 2	750/850.	450/550	without accelerator.
Mk 2*	750/850.	450/550	without accelerator.
Mk 3	750/850.	———	Fixed accelerator.
Mk 3*	———	450/550	No accelerator.

The use of Accelerators has been discontinued (ACI 313 of 1942).

As the Mks 3 and 3* are the Guns that are used most extensively, below is a brief description and differences:—

The Mk 3 is a simplified pattern with a fixed high rate of fire, no accelerator is fitted but the accelerator springs are embodied in the Block, Guide Spring Return (Mk 3). A shorter Return Spring (Mk 2) is fitted due to the space taken up by the larger type Guide Spring Return. The Mk 2 Belt

Guide has no Catch and there is no recess for a Catch in the Body, no housing for the Accelerator and the raised portion of the floor extends further forward than in earlier patterns.

The Mk 3* differs from the Mk. 3 chiefly in having a fixed low rate of fire. A shorter bodied Guide, Spring Return (Mk 4) is fitted with no Accelerator Springs. The Mk 1 Return Spring is fitted. The raised portion of the floor of the Body is machined back to a position similar to the pre-Mk 3 patterns of Gun, to provide sufficient clearance for the rear end of the Piston Extension during its rearward travel. A recess is provided for the Catch of the Mk 1 Belt Guide.

Ammunition

The 7.92 mm. BESA MG fires a rimless cartridge. The base of the cartridge is stamped with the Mark, Contractors Initials and the last two figures of the year of manufacture. The annulus being coloured to indicate the character of the cartridge.

The following marks are used:—

Cartridge	Colour of Annulus
Cartridge, SA Ball 7.92 mm. Mks I and Iz	Purple
Cartridge, SA Armour Piercing 7.92 mm. Mks. Iz and IIz	Green
Cartridge, SA Tracer 7.92 mm. Mks. Iz and IIz	Red
Cartridge, SA Incendiary 7.92 mm. Mks I	Blue

Drill and Dummy Cartridges are also available.

To Load

Grasp the Pistol Grip with the right hand with the fingers clear of the Trigger, and pull back the Trigger Guard until the Cocking Catch Lever can be pressed down by the thumbpiece. Slide the Trigger Guard forward as far as it will go, then pull it back until retained by the Cocking Catch. The Gun will then be cocked.

Pass the tag of the belt through the Feed Block from the right and pull to the left as far as it will go. The Gun is then ready to fire. Tuck the end of the tag into the metal chute on the left side of the Cartridge Case Deflector.

To Unload

With the Gun cocked, hold back the Trigger Guard, pull out the Cover Locking Pin, raise the Cover and hold it open by the ring suspended over the Gun. Remove the belt, see that the Chamber is clear, lower the Cover and

engage the Cover Locking Pin. Pull back the Trigger Guard slightly, depress the Cocking Catch Lever by means of the thumbpiece and ease the recoiling portions forward under control. With the Trigger pressed, pull the Trigger Guard back, release the Trigger, then draw the Trigger Guard right back until retained by the Cocking Catch.

STRIPPING AND ASSEMBLING

General Stripping

Precautions

(a) *Always treat the Gun as loaded until proved otherwise.* Cock the Gun, open the Cover, and see that the Chamber is empty.

(b) Do not permit the recoiling portions to fly forward when the Gun is unloaded. Always ease them forward.

(c) The Gas Cylinder is very easily damaged. Avoid the following:—

(1) Attempting to remove or replace the Barrel when the Recoiling Portions are forward.

(2) When replacing the Barrel, knocking the Gas Cylinder against the Body of the Gun.

(3) Firing the Recoiling Portions forward with the Barrel Retainer disengaged.

To Strip

(1) Lift off the rear Baffle Plate. Cock the Gun.

(2) Raise the Carrying Handle until it is just clear of the lug on the right side of the Body and push the Barrel Retainer forward until clear, of the slides of the Body. Raise the Carrying Handle to the vertical position, lift the rear of the Barrel and push it forward until the guides on the Barrel Sleeve are disengaged from the guides at the front of the Body.

(3) Pull out the Cover Locking Pin as far as it will go. Remove the Cover.

(4) Press in the Belt Guide Catch (if fitted) and lift the Belt Guide from its housing in the Body.

(5) Lift the Feed Block from the Body and slip out the Feed Slide.

(6) Remove the Breech Block by lifting the rear and sliding it out backwards.

(7) If the Gun has an Accelerator fitted, remove by pulling out the Accelerator arm plunger from the Body, turning it downward and lifting the Accelerator from its seating in the Body.

(8) Ease the recoiling portions forward.

(9) Press the Block, Guide Spring Return forward, and lifting, remove it with the Return Spring from the Body.

(10) With one hand on the Piston Extension, and the other at the rear end of the Barrel Extension, lift out the Piston and Barrel Extension. Slide the Piston Extension from the Barrel Extension.

(11) Lift out the Feed Lever.

(12) Raise the Trigger Guard Catch. Grasp the Pistol Grip, squeeze the Trigger, draw the Trigger Guard to the rear as far as it will go, release the Trigger, and again draw the Trigger Guard to the rear until it is fully disengaged from the Gun.

Detailed Stripping

Gas Cylinder

With a punch or the point of a round, depress the Gas Cylinder Sleeve Spring, and using the spanner end of the Combination Tool, rotate the Gas Cylinder Sleeve until it is free of its housing in the Barrel. Swing the rear end of the Gas Cylinder away from the Barrel Sleeve. Tap the Gas Regulator out of the Cylinder with a copper hammer or brass drift. Slip off the Gas Cylinder Sleeve and Spring.

Breech Block

Turn the Breech Block upside down, lift the front end of the Extractor Stay until it is disengaged from the Extractor and remove it together with its Spring. Lift out the Extractor. Turn the Breech Block upright, press the Firing Pin Retainer down with a drift. The Spring will force the Firing Pin out.

Trigger Guard Mk 2

(a) Remove the Split Pin from the Cocking Catch Thumbpiece and remove the Lever Catch Cocking.

(b) Drive out the Pin Catch Cocking, press the Trigger and remove the Catch and Spring.

(c) Turn the Lever Locking Catch Safety to the "OFF" position. Push the Tripper Sear forward until its shoulders disengage from the Shaft Trigger. Unscrew the Shaft Trigger from the Connectors Trigger. Remove Shaft Trigger, Tripper Sear and Spring Trigger.

(d) Using a drift push out the Pin Sear and lift out the Sear and Spring Sear. Remove the Pin Catch Safety and the following may then be taken out:— Catch Safety, Spring Catch Safety, Bearing Shaft Trigger.

(e) Remove the Pin Axis Trigger and Trigger, also the Pin connector and Connector.

(f) Rotate the Lever Locking Catch Safety past the "ON" position, taking care not to lose the Detent and Spring, until the recess on the end of the Lever is opposite the flange of the Retainer Lever Locking Catch Safety. Withdraw the Lever.

(g) Unscrew the Plug Screw Pistol Grip, remove the Bracket Lever Safety Catch and Lever.

(h) Remove the Rod Safety Catch, Tube pistol Grip and Grip.
TO ASSEMBLE, REVERSE THE STRIPPING SEQUENCE

NOTE:—In a Mk 3 Trigger Guard, there is NO Safety Catch. Ensure that the Bearing Shaft Trigger is replaced with the Boss Facing Rear and the Connector Trigger with the Boss Facing Frontwards.

Detailed Assembly

Gas Cylinder

Replace the Gas Cylinder Sleeve Spring in the Gas Cylinder. Slip on the Gas Cylinder Sleeve, with the interuptions on the opposite side of the Spring. Depress the Spring and push down the Sleeve so that it holds the Spring depressed. Insert the Gas Regulator into the Gas Cylinder. Engage the flange on the Gas Cylinder in its housing in the Barrel Sleeve and swing the Cylinder to the rear until it lies on the Barrel. With the combination tool, rotate the Gas Cylinder Sleeve until it engages in its housing in the Barrel Sleeve.

Breech Block

Assemble the Spring to the Firing Pin, and with the Retainer still down, press the Pin and Spring into the Breech Block taking care that the slot in the Pin is facing the Retainer. Push home the Retainer. Turn the Breech Block upside down and slide the Extractor into the guides. Assemble the Spring to the Stay Extractor and place them in the Breech Block, rear end first, with the projection uppermost. Press in the front end of the Stay Extractor until it is retained.

General Assembly

1. Raise the Trigger Guard Catch and engage the flanges of the Trigger Guard with the guides in the Body, with the Cocking Catch Thumbpiece depressed, slide forward the Trigger Guard, keeping the fingers clear of the Trigger.

Release the Cocking Catch Thumbpiece and drop the Trigger Guard Catch. Pull the Trigger Guard back until the Cocking Catch engages with the Body.

2. Replace the Feed Lever and swing its upper arm out to the right.

3. Slide the upper flanges of the Piston Extension into the lower groove of the Barrel Extension. With the Piston in the forward position, lower the Piston and Barrel Extension into the Body.

4. Assemble the Return Spring over the Guide Return Spring. Grasp the top of the Return Spring Guide Block with the right hand and insert the free end of the Spring into the Piston Extension. With the left hand supporting the Spring, force the Return Spring Guide forward until the Guide Rod enters the Body, and then press the Guide downwards and release. Ensure that it is correctly positioned.

5. Cock the Gun, keeping one hand pressed on the Barrel Extension.

6. Replace the Accelerator (if fitted) and engage the Plunger.

7. Replace the Breech Block, making sure that it is properly seated down on to the Piston Extension.

8. Slip the Feed Slide into the Feed Block and position the left edge of the Slide itself in line with the left edge of the Feed Block. Lower the Feed Block into the Body and ensure that the stud on the Slide is engaged with the slot in the Feed Arm.

9. Replace the Belt Guide in the Body and press it downwards until the Catch (if fitted) is engaged.

10. Engage the Cover with the trunnions on the Body, close the Cover and engage the Cover Locking Pin.

11. Take hold of the Barrel Carrying Handle and raise the rear end of the Barrel. Keeping the Gas Cylinder clear of the Body, engage the guides on the Barrel Sleeve with the guides at the foot of the Body. Pull the Barrel to the rear and lower the breech end into the Barrel Extension. Push the Carrying Handle over to the right so that it rests on the ramps, knock back the Handle with the hand and push it down into the locked position.

12. Replace the rear Baffle Plate.

13. Ease the recoiling portions forward.

14. Test the Gun for correct assembly by cocking and easing the recoiling portions forward again.

Removal of the Retaining Pawl and Cover Locking Pin

NOTE:—These components should only be stripped from the Gun for replacement or examination purposes.

(a) **To remove the retaining pawl**

The Cartridge Guide must first be removed from the Cover of the Gun and this is done most conveniently whilst the Cover is assembled to the Gun.

1. Obtain a piece of wood approx. one inch square, and seven inches long. Raise the Cover to the vertical position, insert the piece of wood between the rear end of the Barrel Extension and the front Recoil Spring Casing. Pull rearwards on the Cover until the Recoil Spring is fully compressed.
2. Whilst in this position, slide the Cartridge Guide out to the right. With a fine punch, drive out the Retaining Pawl Pin and remove the Retaining Pawl and Spring from the Cartridge Guide.
3. After the removal of the Cartridge Guide, the Recoil Spring and Front and Rear Recoil Spring Casings may be removed by sliding them out of their seating in the Cover.

(b) **To Assemble the Retaining Pawl**

1. Replace the Recoil Spring and Casings if they have been removed.
2. Place the Retaining Pawl and Spring in the Cartridge Guide and re-assemble the Pin.
3. Compress the Recoil Spring as instructed for stripping, slide the Cartridge Guide into position and release the pressure on the Recoil Spring.

(c) **To Remove the Cover Locking Pin**

1. Pull out the Pin to the right.
2. Insert a fine punch or the shank of a drill (about .05" dia.) through the hole in the right hand corner of the Cover and into the small hole through the Locking Pin.
3. Depress the Retainer by applying pressure to the punch and move the Locking Pin to the right as far as possible.
4. Withdraw the punch and remove the Locking Pin.
5. The Retainer and Spring may now be removed from their housing in the Cover.

(d) **To Assemble the Cover Locking Pin**

1. Replace the Retainer and Spring in the Cover.
2. With a punch, press in the Retainer as far as possible, place the Cover Locking Pin, groove forward, into the Cover and press to the left.
3. Withdraw the punch and press in the Locking Pin until held by the Retainer.

NOTE:—Normally the Cover Locking Pin is assembled with the head to the right, but it may be assembled with the head to the left if circumstances require it, the Retainer and Spring being assembled in the housing in the left corner of the Cover.

ACTION OF THE MECHANISM

Forward Action

Assuming the Action to be Cocked and Loaded.

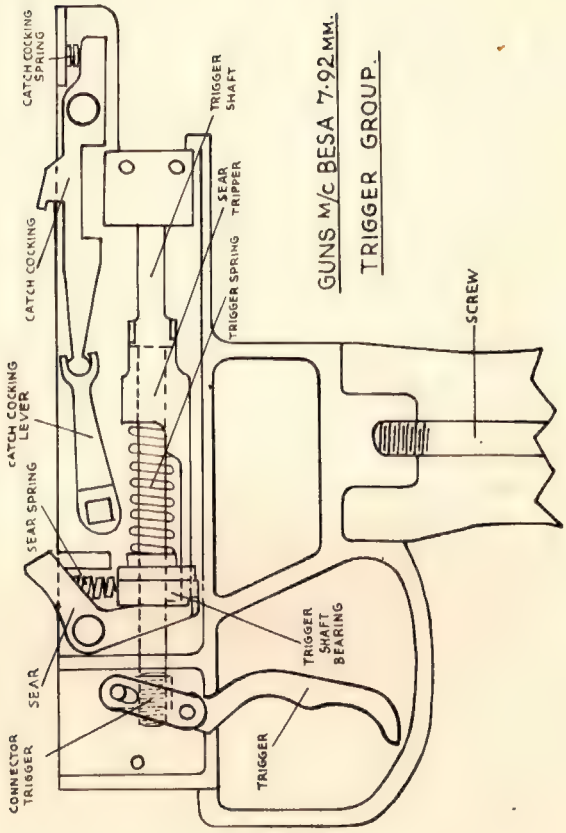
On pressure being applied to the Trigger, the nose of the Sear is disengaged from the bent of the Piston Extension. The Return Spring reasserts itself and drives the Piston Extension and Breech Block forward.

The Feed Projection on the Breech Block drives a round out of the Belt and into the Chamber. The Stud on the Bottom Arm of the Feed Lever being engaged in the Cam Groove on the underside of the Piston Extension moves the Upper Arm of the Feed Lever from left to right, carrying with it the Feed Slide and Pawl. The Feed Pawl is depressed by the next round in the Belt, compressing its Spring, until the Feed Pawl is free to rise again under the influence of its Spring to engage behind the next link in the Belt. During this movement, the Belt is retained in position by the Retaining Pawl.

The Piston Extension and Breech Block continue their forward movement together, until the rear of the Breech Block is lifted by its ramps bearing on the Studs on the inside of the Barrel Extension, out of the right angle face on the rear of the Piston Extension and on to the inclined ramp which lifts the rear end of the Breech Block up into engagement with the Locking Shoulders of the Barrel Extension, thus locking the action. The Breech Block is arrested when it contacts The Stops in The Barrel Extension.

The Extractor now has no influence over the round in the Chamber due to the Stay Extractor being positioned in the deep portion of its recess in the Piston Extension.

The Piston Extension has approximately another 5/16" of further forward travel before the Post Piston strikes the Firing Pin, driving it forward and compressing its Spring to fire the charge.


GUNS M/c BESA 7·92 MM.
TRIGGER GROUP.
CATCH COCKING SPRING
CATCH COCKING
CATCH COCKING LEVER
SEAR SPRING
SEAR
CONNECTOR TRIGGER
TRIGGER SHAFT
SEAR TRIPPER
TRIGGER SPRING
SCREW
TRIGGER SHAFT BEARING
TRIGGER

Backward Action

Assuming the Gun to have just Fired,

The force of the explosion forces the Barrel, Barrel Extension, Piston Extension and Breech Block all locked together to the rear, compressing the Recoil Spring.

A portion of the propellant gases pass through the gas vent in the Barrel, through the Gas Regulator and into the Gas Cylinder to impinge on the head of the Piston, driving it to the rear and compressing the Return Spring. The Post Piston moves away from the Pin Firing which is withdrawn to the rear by the action of its compressed Spring reasserting itself.

During the first 5/16" approximately, of the backward travel of the Piston Extension, the Breech Block remains in engagement with the Locking Shoulders of the Barrel Extension, thus ensuring that the action remains locked until after the bullet has left the Barrel.

The Piston Extension continues its backward travel and the ramp on its rear end moves away from the Breech Block. The inclined tongue of the Piston Post bearing against the inclined face in the rear of the Breech Block, forces the Breech Block down out of engagement with the Locking Shoulders of the Barrel Extension. Thus unlocking the Action.

The Stay Extractor, bearing on its inclined groove in the Piston Extension, forces up the Extractor to grip the empty case.

The Piston and Breech Block now continue their backward travel together, withdrawing the empty case from the Chamber. As they move to the rear, the Ejector strikes the empty case forcing it off the face of the Breech Block and ejecting it downwards through the ejection opening in the Piston Extension.

The Stud on the Lower Arm of the Feed Lever being engaged in the Cam Groove on the underside of the Piston Extension moves the Upper Arm of the Feed Lever from right to left, carrying with it the Feed Slide and Pawl. The Feed Pawl, being engaged behind the next round in the Belt carries it to the left, the nose of the round being forced down into line with the Chamber by the Cartridge Guide Ramps. The round raises the Retaining Pawl compressing its Spring, until it has been carried fully to the left against the Cartridge Stops when the Retaining Pawl is forced down again by its Spring, to engage behind the upper surface of the Belt Link which is held by the Feed Pawl.

The Piston Extension and Breech Block continue their backward movement, fully compressing the Return Spring. When the Recoil Energy has been absorbed, the Return Spring reasserts itself and drives the Piston Extension and Breech Block forward again.

Until pressure on the Trigger is released, the Belt is empty or a Stoppage occurs the Gun will continue to fire.

Action of the Trigger Mechanism

On pressure being applied to the Trigger it rotates on its axis, the top portion moving forward. The Trigger Shaft being attached to the Trigger through the medium of the Trigger Connector moves forward, the Sear Tripper being in engagement with the Shaft also moves forward and the Trigger Spring is compressed between it and the Trigger Shaft Bearing.

The tongue portion of the Tripper bears against the lower arm of the Sear, rotating the Sear on its axis, disengaging the upper arm from the bent of the Piston and compressing the Spring Sear.

The Sear is prevented from moving too far down by the lug under the upper bent meeting the Trigger Shaft Bearing.

On releasing the Trigger the Trigger Shaft and Tripper move to the rear under the influence of the compressed Trigger Spring, as the tongue on the Tripper moves clear of the Sear, the latter rises under the influence of the Sear Spring ready to engage the bent of the Piston.

NOTE:—

Action when a Safety Catch Lever is fitted. (Mk 2 Trigger Guard).

On pressing the Safety Catch Lever the rod is forced forward to engage the tail of the Safety Catch, which is rotated, its arm disengages from the bent of the Tripper and its head moves away from the underside of the Sear. During this movement the Catch Spring is compressed.

Safety

The Cocking Catch cannot be lowered when the Trigger is pressed, owing to the solid portion of the Trigger Shaft being directly below the projection on the Catch Cocking.

The Trgiger cannot be operated when the Cocking Catch is lowered, owing to the projection on the Cocking Catch being in front of the solid portion of the Trigger Shaft.

Action of the Cocking Catch

Pressure on the thumbpiece rotates the Lever Catch Cocking, lowering the forked end which in turn lowers the front end of the Catch Cocking, freeing the bent from its recess in the Body.

Action of the Accelerator

With the Accelerator set at "LOW" the recoiling portions move to the rear as far as possible and the Gun fires at the "slow" rate i.e. 450/550 rounds per minute.

With the Accelerator set at "HIGH" the backward movement of the recoiling portions is limited. The Piston Extension striking the Accelerator imparting extra speed to the recoiling portions in their forward movement, increasing speed to approximately 800 rounds per minute.

The Mk 3 Gun has a fixed Accelerator.

The Mk 3* Gun has NO Accelerator.

EXAMINATION, TESTS AND ADJUSTMENTS

Ensure the weapon is unloaded.

Examine for general condition, burrs, damage and wear on component parts.

View the bore of the Barrel, examine for cuts, corrosion etc., particular attention being paid to bulges. Test the Chamber with Dummy Cartridges and ensure that the Barrel Plug 7.85 mm. (.3088") runs through the bore freely. See that the Bullet Guide on the Breech Face has been made (EME, Reg SA and MG E 647 Mod Inst No. 3).

If the Barrel is suspected of being worn, carry out the accuracy test in accordance with ERs Part 1. Check the Gas Cylinder for fractures on the flange which seats in the Barrel Sleeve.

If the Cover overturns and jams, this can be remedied by careful welding where worn. Ensure the correct functioning of the Trigger Mechanism.

Examine the Breech Block for fractures, pitted face, worn or pitted Firing Pin Hole. (Test with a known GOOD Firing Pin.)

There should be a little lateral movement between the Piston and Piston Extension, ensure that the head of the Piston is not worn or burred. It may be necessary to remove any "HIGH" spots on the "Parkerising" of the Piston, Breech Block or Barrel Extension. Assemble the Piston and Breech Block to the Barrel Extension, and ensure that there is a trace of end-play between the Breech Block and the Barrel Extension. Clearance between locking shoulder on B.B. and locking shoulder on barrel Extension — .006"—.012".

Ensure that there is .004"—.012" clearance between the face of the Barrel and the projections on the Breech Block.

Test the Cartridge Headspace as follows:—

Remove the Return Spring Guide and Spring Return from the Gun, and the Extractor from the Breech Block. Ensure that the Chamber is clean and free from burrs. Insert the 47.22 mm. CHS Gauge into the Chamber, slide the Piston gently forward. The Breech should LOCK.

Remove the gauge and insert the 47.50 mm. CHS gauge, the breech should NOT LOCK.

Should the breech fail to lock with the 47.22 mm. gauge examine for burrs and foreign matter.

Should the Breech Block close with the 47.50 mm. gauge, there is wear. Try a new Barrel. If the breech still locks, the Gun will be BLR. When a new barrel is fitted the old one must be returned.

Assemble the Breech Block to the Piston, place the rear end on the bench in a vertical position. Move the Breech Block to the locked position and test the protrusion of the Firing Pin. Gauge the limits as follows:—

1.55 mm. high, and 1.10 mm. low.

If low, exchange the Firing Pin; if high, stone down, maintaining the correct radius of the Firing Pin.

Assemble the Gun, and with Belt and Dummies test for cunctioning. If sluggishness is detected in the forward movement of the recoiling portions, ensure they are free from undue friction. A weak Return Spring may be the cause of this. All Guns except the Mk 3 should have a Mk 1 Return Spring:—Free Length $20^{7}/_{8}$", Condemnation Limit 19". The Mk 3 Gun has a Mk 2 Return Spring:—Free Length $19^{1}/_{8}$", Condemnation Limit 18" ($17^{1}/_{2}$").

Ensure that the Flash Eliminator is screwed fully home. Should it become undone, the Barrel Sleeve will move forward on the Barrel giving mal-alignment of the gas holes in the Barrel and Barrel Sleeve, resulting in lack of gases on the Piston and consequently may fail to drive the recoiling portions to the rear.

Fit an "S" Pawl Retaining where not already fitted.

To remove fouling from the Gas Chambers of Mks 2 and 3 Gas Cylinders use the correct tool, "Tools Removing Fouling Besa 7.92 mm. MG Mk 1." When cleaning the gas holes in the Gas Regulator, Cylinder and Barrel, use the correct reamers.

SEE "POINTS TO NOTE."

Barrels will not be assembled into a Sleeve, if a Barrel is found to be "US", a Barrel with Sleeve must be fitted.

Covers will not be replaced, Gun to be "BLR."

If the Feed Pawl is found to be "US", the Slide complete will be exchanged.

Should it be found necessary to replace a Trigger Guard Body, the Trigger Guard assembled will be replaced.

POINTS TO NOTE

Cleaners Gas Regulator

No.	*REAMERS*		*Dia in Inches*	*Use*
	Mk 1	*Mk 1**		
1.	Yes	Yes	.082	Mk 1 Gas Regulator No. 1 hole.
2.	Yes	Yes	.094	Mks 1 to 3 Gas Regulators No. 2 hole.
3.	Yes	Yes	.106	Mk 1 Gas Regulator No. 3 hole.
4.	Yes	Yes	.118	Mks 1 to 3 Gas Regulators No. 4 hole.
5.	Yes	Yes	.126	Gas Hole in the Barrel.
6.	Yes	Yes	.126	Axial Hole in the Gas Cylinder.
7.	Yes	Yes	.236	Short Hole in the Gas Cylinder.
8.	No	Yes	.149	
9.	No	Yes	—	Coned End of the Gas Chamber in Mks 2 and 3 Gas Cylinder.

If a Clearing Plug is not available, a $^{7}/_{16}$" Bolt with Nut may be used to extract separated cases.

Barrels 7.92 mm. Besa MG

	Mark 1	*Mark 2*	*Mark 2**	*Mark 3*
Locking Plate	—	Long	Long	Minimum in size
Sleeve between the Flash Eliminator and the Barrel		Fitted	Fitted	Fitted
Sleeve Gas Cylinder	Single Locking	Double Locking.		
Gas Regulator and Chamber	Vents and four Ports	No Vents and Two Ports.		

Extractor Group

A similarity exists between the Extractor, Stay Extractor, and Spring Stay Extractor of the Besa 7.92 mm. and Bren .303" Guns.

Normally the Extractor and Stay Extractor are stamped. "T" for Besa and "B" for Bren.

It will be realised that it is impossible to mark the Springs Stay Extractor, but the Besa Spring Stay Extractor (1.1") is longer than the Bren Spring Stay Extractor.

Belts 7.92 mm.

The Mk. 1 consists of 225 metallic links connected by pins, with a steel tag and a twisted wire eyelet. The Cartridges are retained by the small bulge at the rear seating into the Extractor Groove. Part of the link is serrated to assist the Feed Pawl to grip.

This Mk of Belt is OBSOLESCENT.

The Mk 1* is similar to the Mk 1 but has a flexible webbing extension with a wire loop to replace the metal tag and eyelet.

These are termed "metal" belts and are factory packed, but can be used for demonstration and instruction.

The Mk 2 consists of 226 clips, each of two portions, top and bottom, locked together to clamp a canvas webbing strip. The last clip has a wooden plug in it to prevent the Belt from jamming when leaving the Gun. The entry end is rivetted to a steel tab and linked to a rectangular mild steel or brass wire handle.

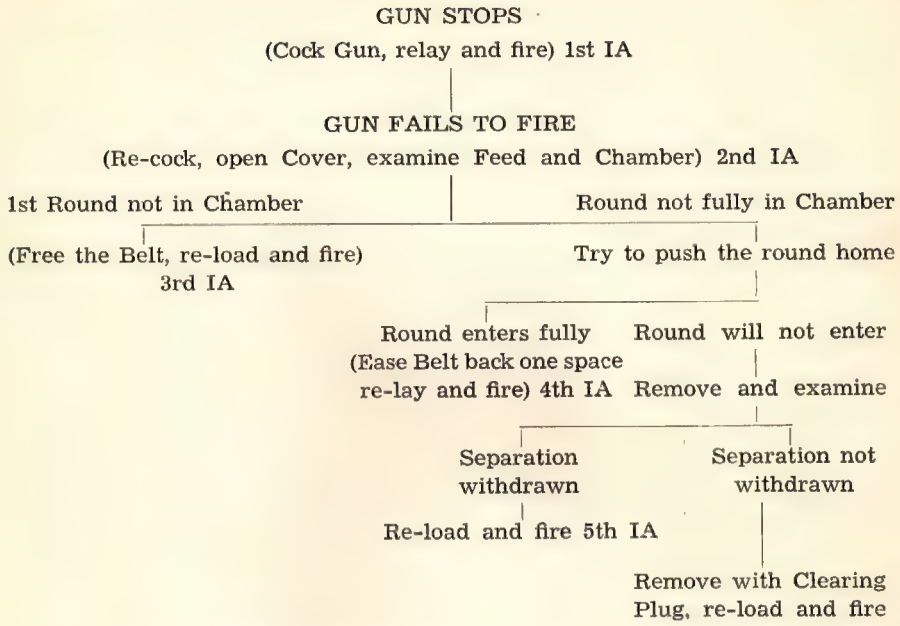
This Mk of Belt is OBSOLESCENT.

The Mk 2c is similar to the Mk 2, comprising the round top clip of the Mk 2 belt, but the bottom clip of the Mk 3 Belt.

The Mk 3 differs from the Mk 2 only in that the top clip is flat instead of being round.

NOTE:—It was found that Mk 3 Belts were causing stoppages in the Mk 3* Guns and these were replaced by the Mk 2 and Mk 2c.

STOPPAGES



When clearing Stoppages certain precautions must be taken:—

1. Keep the fingers clear of the Trigger when cocking.
2. Do not release the Trigger Guard until it is engaged by the Cocking Catch.
3. Double Feed may be caused by drawing the recoiling portions only partially to the rear, allowing them to go forward again, and re-cocking. The round in the Chamber may be fired by the next round.
4. When a Stoppage occurs ensure that the bullet is not in the bore.
5. Clear the Chamber as quickly as possible as a "Cook Off" may take place.

NOTE:—Special Cartridges are supplied for clearing bullets in the bore.

Guns machine Besa 7.92 m.m.

Regulations affecting the above weapon.

LIST OF CHANGES

Para	*Date*	*Detail*	
B 3712	Aug 40	Mks 1 and 2. Accessories for the Gun	
B 3715		Cleaners Gas Regulator (1)	Introduction
B 4257	Jan 41	Brushes Rod Cleaning Cylinder Besa Mk 1	Introduction
		Rods Cleaning Cylinder Bren	Extended Use
B 4747	June 41	Mtgs. 2pdr and Medium Besa MG No. 4 & 5	Introduction
B 5283	Nov 41	Tools Combination Besa Mk 1	Obsolescent
		Tools Combination Besa Mk 2	Introduction
B 5408	Dec 41	Plug Clearing Mk 2	Introduction
B 6064	Apr 42	Belts, 225 rounds Mk 1	Obsolescent
		Belts, 225 rounds Mk 1*	Introduction
		Boxes Belt Ammunition Besa Mk 1	Obsolescent
		Boxes Belt Ammunition Besa Mk 1*	Introduction
		Punches, Brass, Besa Mk 1	Obsolescent
		Punches, Steel, Besa 7.92 mm. (SEE PARA B 7345 FEB 43)	Obsolescent
B 6866	Oct 42	Guns Machine Besa 7.92 mm. Mk 2	
		Guns Machine Besa 7.92 mm. Mk 3	New Pattern
		Guns Machine Besa 7.92 mm. Mk 3*	
		Guns Machine Besa 7.92 mm. Mk 2	
		Guns Machine Besa 7.92 mm. Mk 2*	Obsolescent
		Guns Machine Besa 7.92 mm. Mk 3	
		Guns Machine Besa 7.92 mm. Mk 3	Modification to Mk 3* pattern
B 4141	Dec 42	Cleaners Gas Regulator Besa Mk 1*	
		(1) No. 8 Reamer	Obsolescent
		(2)	Nomenclature
		Tools Removing Fouling Besa Mk 1* (for Mk 3 Gas Regulators)	
		(3)	Nomenclature
B 7345	Feb 43	Punches, Steel Besa 7.92 mm.	Re-introduction
B 7671	May 43	Boxes Spare Parts and Tools No. 1 Mk 1	
		Deflectors Cartridge	Introduction
		Packs Spare Parts	
		Shoulder Pieces MG No. 8	
C 261	Feb 45	Gauges CHS 47.50 mm. Mk 1	Introduction
		Gauges CHS 47.42 mm.	Obsolescent

Para	*Date*	*Detail*	
C 262	Feb 45	Cylinders Gas Mk 4	New Pattern
		Cylinders Gas Mk 3	Obsolescent
C 1029	Jul 45	Tools Cleaning Cylinder Bore 7.92 Mk 1	Introduction
		Tools Removing Fouling Mk 1	Detail Revised
C 1030	Jul 45	Tools Removing Jammed Cartridge Case 7.92 mm. Mk 1	Introduction

EME REGS

SA and MG

E 640 (21 AG)	Page 1	Differences between Belts Mks 1 to 3.
	Page 1	Testing of cartridge Head Space. Increase of the High Limit.
	Page 3	Shortening of Canvas Chutes on the No. 4 Mk 1 Deflector.

EME REGS

SA and MG

E. 647 Mod. Inst	No. 1	Summary of Previous Modifications.
	No. 2	Marking of "Tools Removing Fouling Besa 7.92".
	No. 3	Cutting of a Bullet Lead in the Barrel.

ARMOURERS' WING
Précis No. SA/31

21 AG and RHINE ARMY TECHNICAL BULLETINS

SA, MG and Mortars

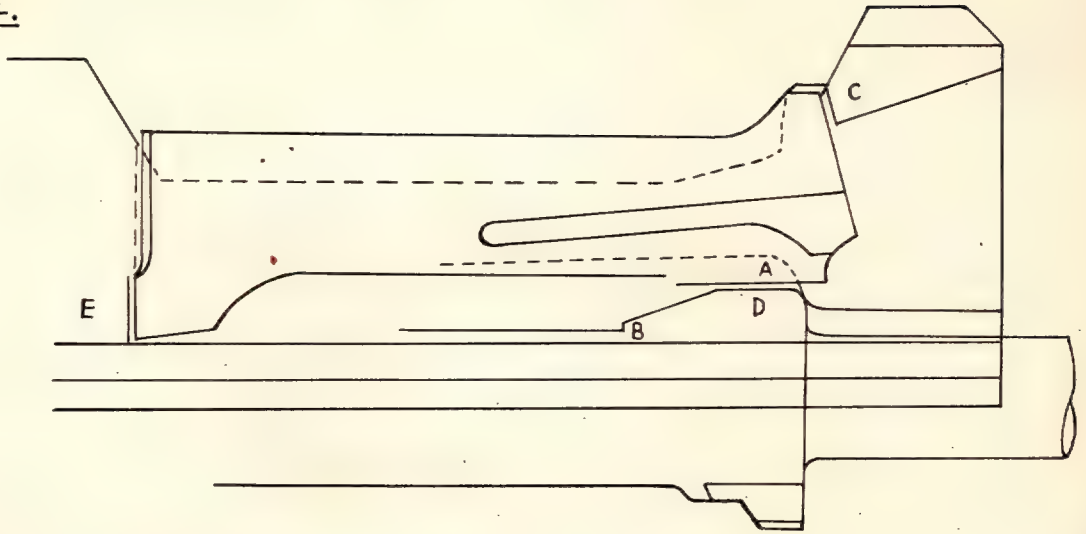
Para. 6	Stamping of "Tools Removing Fouling Besa 7.92 mm."
13	(1) Tool Extractor Cartridge. (2) Tool Cleaning Cylinder Bore. } Sketches and Use
34	Exchanging Mk 3 Belts for Mks 2 or 2c.
48	Belts Ammunition.—Sketch of Differences.
49	Burrs on the Chamber Edge causing damage to cases.
71	Fracturing of Breech Block along the face of the Feed Rib.
7 and 114	Pitted Face of Breech Blocks.
71 and 100	Barrels Bulged immediately behind the Gas Hole.
138	Snubbed Round Stoppage (modified Belt Exit Guide).
139 and 140	Besa solenoid gear firing in the "Comet". Making of a protective shroud.

ARMY COUNCIL INSTRUCTIONS

Para	*Date*	*Detail*
1317	1941	General. Removal of certain components. Mk 2* Guns.
2340		Mks 2* and 3. Modification to the Piston Extension.
2489		Plugs Clearing.
2490		Finished Condition.
313	1942	Mks 1, 2 and 2*. Discontinued use of the Accelerator.
966		Types in the Service.
1025		Mk 2*, 3 and 3*. Modification to the front of the Body.
1027		Removing the high spots—Parkerised Finish.
1210		.004" clearance between the Barrel and Breech Block.
1338		Securing of the Baffle Plates.
1498		Painting of Barrels.
1621		Assembly of the Extractor Group. "B" and "T."
1745		Firing Pin Point Gauge.
1973		Retention of Belt Guides.
459	1943	Modification to the Mk 2 Piston discontinued. (See 1100 of 1942.)
1346		Re-introduction of "Punches Steel."

Locking of Breech

FIG. 4.



Breech Locked

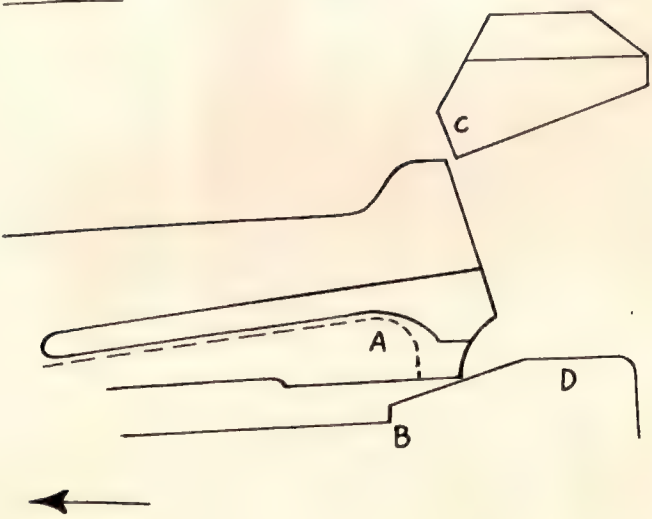
Breech Block Locked in Locking Shoulders in the Barrel Extension "C" and the rear end supported by the flat on the rear of the Piston Extension "D"

BESA MECHANISM

Locking of Breech

Breech Block and
Barrel Extension
Stationary

FIG. 3.

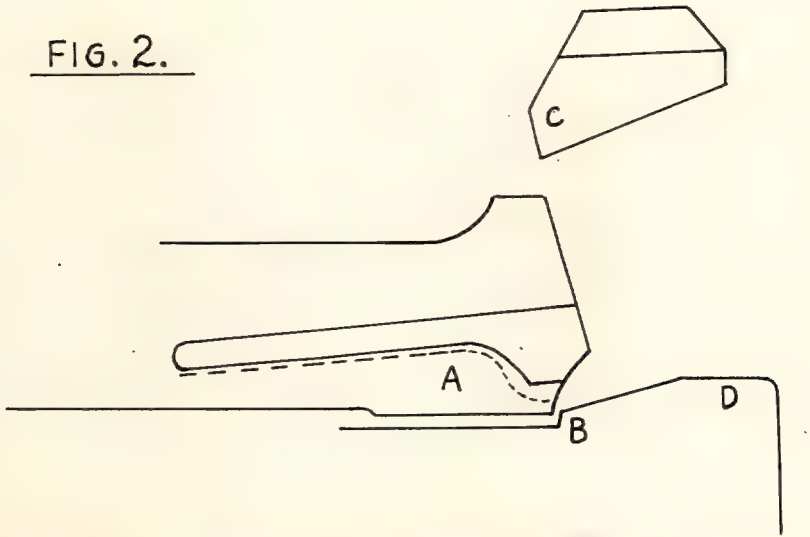


Piston Extension moving forward

Breech Block being raised up into the Locking Shoulder in the Barrel Extension "C" by the sloping surface on the Piston Extension.

Locking of Breech

FIG. 2.

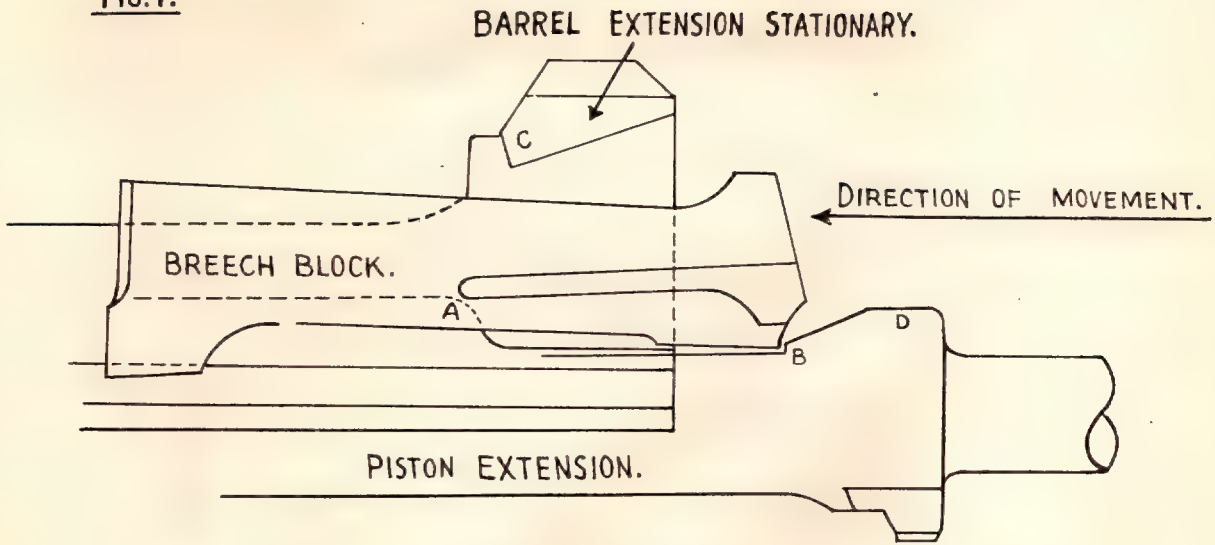


The rear end of the guides on the Breech Block coming into contact with the ramps in the Barrel Extension (Point "A") lifts the rear end of the Breech Block out of the right angle step "B" on the rear of the Piston Extension. Forward movement of the Breech Block is arrested by contact with the Barrel Extension at "E" (See Fig. 4) or the base of the round if there is a round in the Chamber.

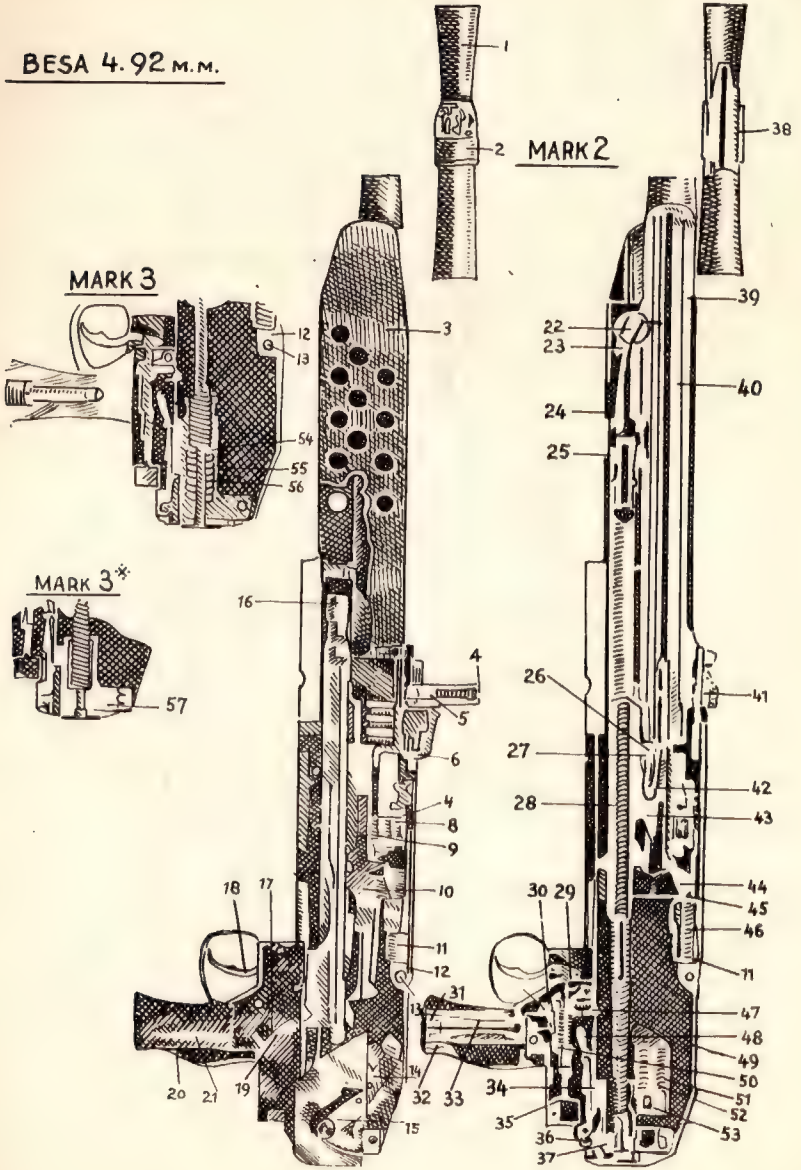
BESA MECHANISM

Locking of Breech

FIG.1.



Breech Block and Piston Extension moving forward, the rear under surface of the Breech Block engages in the right angle bent in the Piston Extension.


BESA 4.92 M.M.
MARK 3
MARK 3*
MARK 2
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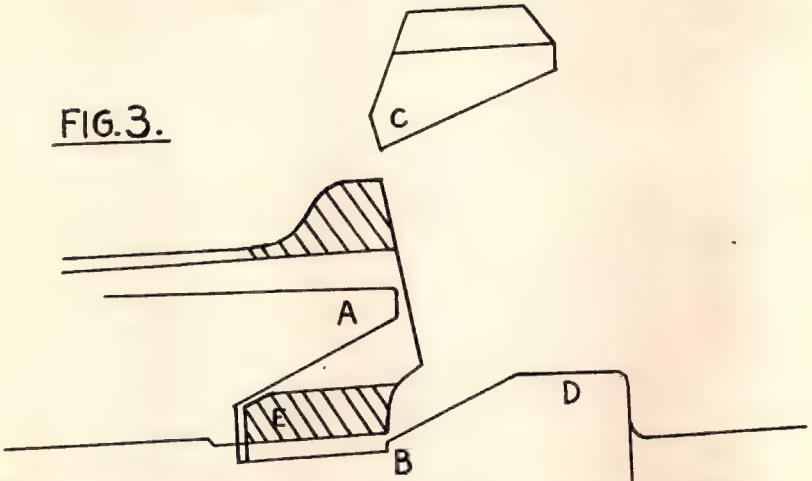
BESA MECHANISM

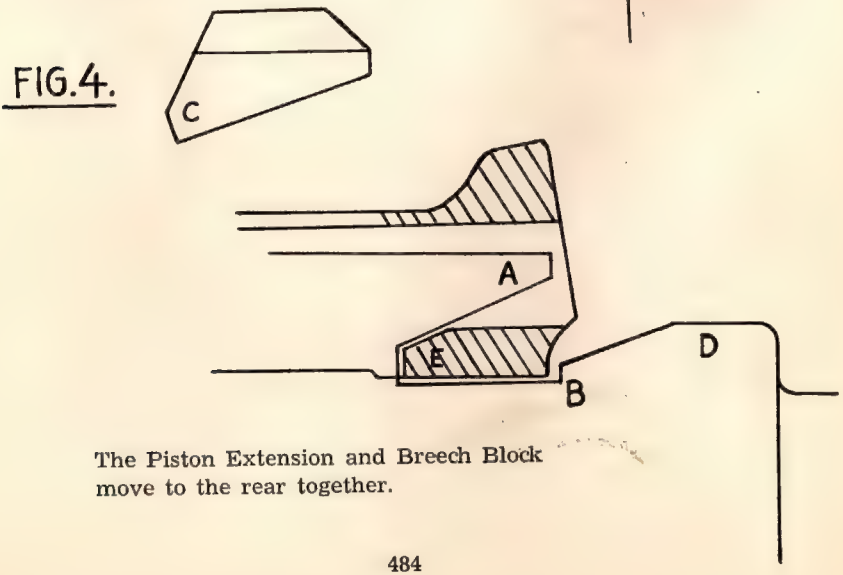
Locking of Breech

FIG.3.



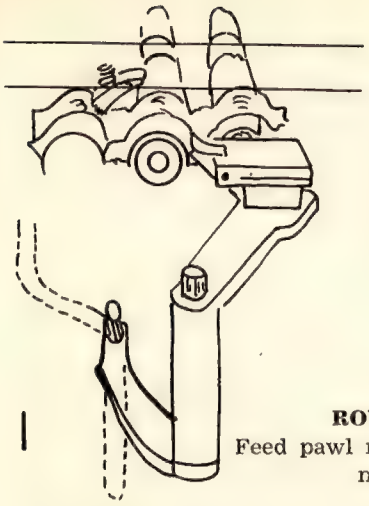
The Breech Block is withdrawn down out of engagement with the Locking Shoulders in the Barrel Extension.

FIG.4.

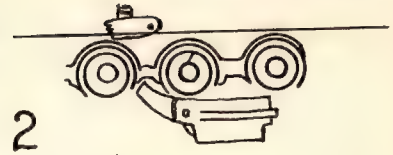


The Piston Extension and Breech Block move to the rear together.

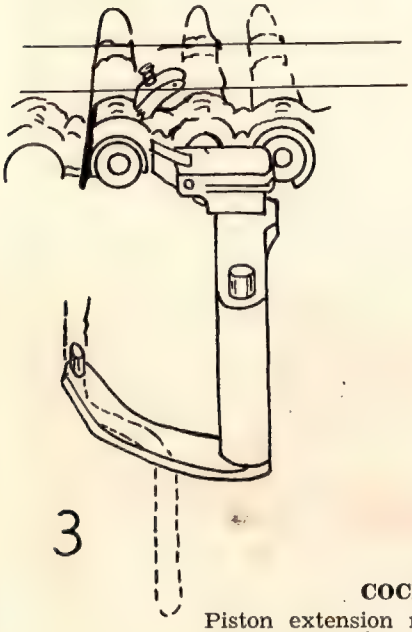
BESA
FEED



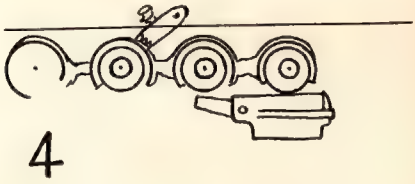
ROUND FIRED
Feed pawl ready to bring across next round.



DURING RECOIL
Feed pawl brings across round, retaining pawl forced up.



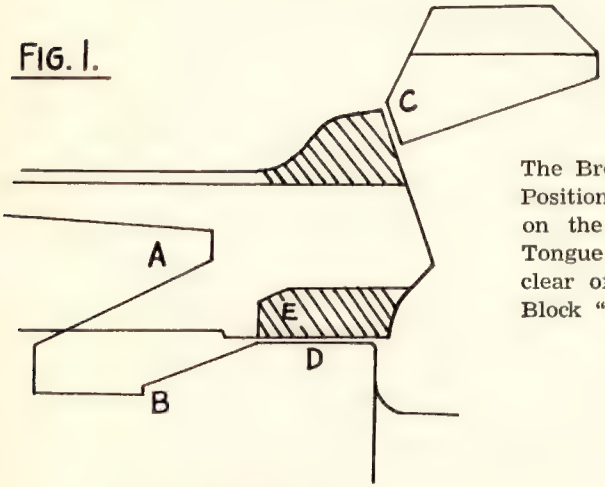
COCKED POSITION
Piston extension moves to rear, round in position, retaining pawl engaged behind round.



DURING FORWARD MOVEMENT
Belt held by retaining pawl, feed pawl rides under next round.

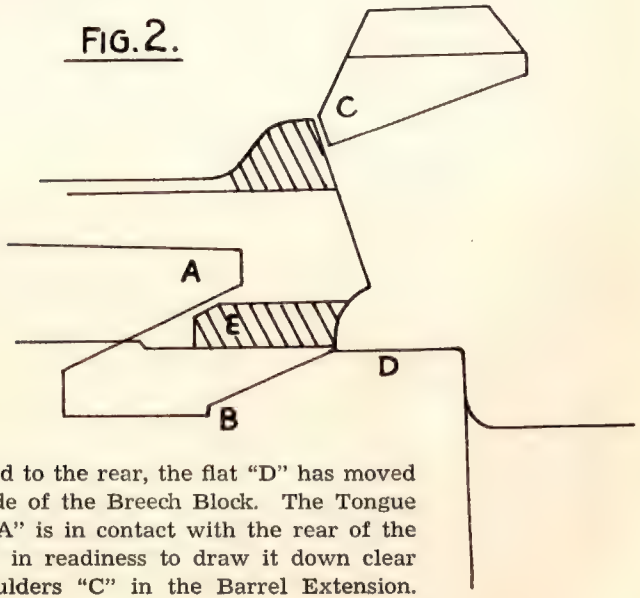
BESA MECHANISM
Unlocking of Breech

FIG. 1.



The Breech Block in the Locked Position, held up by the flat "D" on the Piston Extension. The Tongue of the Piston Post is clear of the rear of the Breech Block "E".

FIG. 2.



The Piston has moved to the rear, the flat "D" has moved clear of the underside of the Breech Block. The Tongue of the Piston Post "A" is in contact with the rear of the Breech Block at "E" in readiness to draw it down clear of the Locking Shoulders "C" in the Barrel Extension.

GUNS MACHINE BESA 7.92 mm

Key to sectional view of gun

1 Eliminators Flash.
2 Distance-piece Flash Eliminator.
3 Body.
4 Handle Carrying.
5 Plunger Handle Carrying.
6 Retainer Barrel.
7 Pawl Retaining.
8 Spring Pawl Retaining.
9 Pawl Feed.
10 Block Breech.
11 Casing Spring Recoil Rear.
12 Block Re-action.
13 Pin Block Re-action.
14 Accelerator.
15 Crank Arm Accelerator.
16 Piston.
17 Body Guard Trigger.
18 Trigger.
19 Thumbpiece Catch Cocking.
20 Lever Catch Safety.
21 Grip Pistol.
22 Regulator Gas.
23 Cylinder Gas.
24 Spring Sleeve Gas Cylinder.
25 Sleeve Gas Cylinder.
26 Extractor.
27 Stay Extractor.
28 Spring Return.
29 Connector Trigger.
30 Catch Safety.
31 Plug Tube Pistol Grip.
32 Pin Lever Safety Catch.
33 Tube Grip Pistol.
34 Catch Cocking.
35 Shaft Trigger.
36 Spring Catch Cocking.
37 Block Guide Spring Return.
38 Washer Locking Flash Eliminator.
39 Barrel Sleeve.
40 Barrel.
41 Screw Handle Carrying.
42 Pin Firing.
43 Extension Piston.
44 Extension Barrel.
45 Casing Spring Recoil Front.
46 Spring Recoil.
47 Sear.
48 Lever Catch Cocking.
49 Cover.
50 Tripper Sear.
51 Spring Accelerator Outer.
52 Spring Accelerator Inner.
53 Guide Spring Accelerator.

54 Sleeve Accelerator.
55 Spring Accelerator Outer Mk 2.
56 Spring Accelerator Inner.
57 Guide Spring Return Mk. 4.

} Guide Spring Return Mk. 3.

GUNS M/C VICKERS .303" Mk 1

GENERAL INFORMATION

The Gun M/c Vickers .303" Mk 1 is a fully automatic, belt fed, medium machine gun. It is operated by recoil, assisted by gas and is water cooled. It is fired from a heavy tripod mounting.

GENERAL CHARACTERISTICS

Weight of gun without water	28½—32 lbs.
Weight of gun with water	38½—42 lbs.
Rate of fire	500 rds. per min.
System of cooling	Water jacket holding 7 pts.
System of sighting	Tangent aperture backsight and blade foresight. Has fixed battlesight sighted to 400 yds.

The wide variation in weights is brought about by the different types of barrel casings. One is of thin, corrugated steel, while the other type is constructed of thick steel which is not corrugated. The former type of barrel casing makes the gun 3½ lbs lighter than the other type.

The Vickers gun has also been produced in suitable form for fitting to AFVs. These later marks are not now in use, and in this chapter we are concerned only with the Mk 1.

FEEDING

The Mk 1 gun is normally feed from the right hand side. Left-hand feed blocks were introduced for use in AFVs on the later types of guns. The feeding is effected by a fabric belt holding 250 rds. For drill purposes only a 50 round belt is issued.

COOLING

The Vickers gun has a barrel casing or water jacket, through which the barrel passes. This casing holds 7 pints of water. The water is estimated to boil after 600 rounds if fired continuously, and will evaporate at the rate of 1½ pints every 500 rounds, after boiling point has been reached. A steam tube is fitted inside the barrel casing through which the steam can pass to a condenser can and be reconverted into water.

SIGHTING

The original tangent backsight was graduated up to 2900 yds. With the introduction of Mk 8z (High velocity) ammunition, it was necessary to alter these graduations to accommodate the greater range. The graduated plate was therefore inverted and its reverse marked with graduations up to 3700 yds. A plate graduated on one side only up to 3700 yds was subsequently introduced. Marks of graduated plates and their readings are as follows:—

Mark 1 . . . . . Graduated on one side only, up to 2900 yds.
Mark 1* . . . . . A Mark 1 graduated on the reverse up to 3700 yds.
Mark 2 . . . . . Graduated on one side only up to 3700 yds.
The Mks 1 and 2 are Obsolescent.

PACKING

As the barrel passes right through the barrel casing it is necessary to incorporate some means of packing or washering around the barrel apertures in the casing, to prevent leakage of water, and at the same time not interfere with the barrels movement during recoil. This is accomplished by packing with asbestos cord (a) around the cannelure at the breech end of the barrel and (b) in the gland seating at the front end of the barrel casing. Asbestos packing should first be soaked in oil and then wound tightly into the respetive seatings.

STRIPPING

See that the gun is unloaded. For preference mount on a Mk 4 or Mk 5 Mountings Tripod, drain out the water from the barrel casing, and proceed to remove the parts in the following order.

(i) **Lock.**—Raise the rear cover, pull back the crank handle, lift out the lock from the guides on the side plates, rotate it 60 degrees on the connecting rod and lift off. Ease the rank handle forward, and press back the trigger of the lock to ease the lock spring.

(ii) **Feed-block.**—Turn up the front cover catch, raise the front cover, and lift out the feed-block.

(iii) **Fusee spring box with spring, etc.**—Press the box forward to clear the front and rear studs, draw outwards and detach the hook of the spring from the fusee chain. Turn the fusee rearward and pull out from the crank.

(iv) **Muzzle attachment.**—Unscrew the front cone, pull out the split keeper pin, turn the outer casing 60 degrees and draw it off the gland. Unscrew and remove the muzzle cup and the gland and withdraw the asbestos packing. Should the details special to blank firing be

assembled and it is desired to remove the adjusting screw from the front cone, the lock nut may be unscrewed from the inside end of the cone when the latter is removed and held in a vice.

When owing to the presence of fouling any of the parts have become set they should be saturated with paraffin oil and, if possible, left for a time before attempting to remove them.

(v) **"T" fixing pin:**—Raise the rear cover, unscrew and remove the "T" pin and hinge down the rear crosspiece.

(vi) **Slides, left and right:**—Withdraw them from the outside plates of the breech casing.

(vii) **Recoiling portions:**—Grasp the crank handle axis, draw out the recoiling portions sufficiently to enable first the left side plate and secondly the right side plate with the crank, etc., to be disconnected from the barrel then remove the barrel.

(viii) **Tangent sight:**—Unscrew and remove the axis pin, and remove the sight, piston and spring.

(ix) **Rear cover lock:**—Unscrew and remove the axis pin, and remove the lock cover and spring.

(x) **Trigger bar:**—Remove the spring and withdraw the bar.

(xi) **Front and rear covers:**—Drive out the keeper pin (plain pin riveted over) or remove the split keeper pin, unscrew the check nut and press out the joint pin. Connect the nut, joint pin and keeper pin to prevent mixing with similar parts of other guns.
NOTE:—These parts should be removed only when replacement is necessary, and must be kept to the same gun.

(xii) **Front cover catch:**—Press the plug, in the end of the catch arm, inward with a screwdriver, give a quarter turn and slowly release, when the plug will be forced out by the spring. Turn the plunger to clear the lugs in the arm and remove. Remove the split keeper pin and catch from the cover.

(xiii) **Rear crosspiece:**—Remove the split keeper pin, unscrew the check nut and press out the joint pin. Remove bracket dial sight.

(xiv) **Foresight:**—Carefully mark location of the sight in the dovetail and then drive out the sight through the right hand protecting wing of the bracket.

(xv) **Steam tube:**—Remove the keeper screw and partly unscrew the tube, then remove the gun from the mounting, up-end the gun, unscrew the steam tube and lift out.

(xvi) **Sliding shutter.**—Place the gun casing, underside up, on a bench, press the catch inward, and push the shutter forward to the stop; maintain pressure on the catch, press in the plunger and push out the shutter to the front.

(xvii) **Check lever.**—With the gun casing in position as for (xvi) drive out keeper pin and remove the lever.

NOTE:—This component must not be removed except for replacement purposes.

To strip the assemblies of the gun

(i) **Feed-block.**—Force out the split pin fixing the top and bottom levers. Separate the levers by driving out the hexagonal stem of the bottom lever from the top lever, and remove the slide; draw out the axis pin of the bottom pawls and remove the spring and pawls.

Remove the top pawls from the fore and aft ends of the axis pin then slide and press out the spring from the lug on the slide. The axis pin should not be removed unless unserviceable.

(ii) **Lock.**—Cock, by pressing up the free end of the side levers. With a punch or cupped end of a "T" fixing pin, force out the split keeper pin and bush axis of the side levers. Remove the side levers and left and right extractor levers, and extractor; ease the lock spring, by pressing the sear and trigger out of engagement to release the firing pin. Push out the tumbler and trigger axis pins and remove the tumbler, trigger, lockspring, firing pin and sear with spring.

(iii) **Extractor.**—Press or tap out the gib spring cover from the dovetailed groove, and remove the gib spring and gib.

(iv) **Rear crosspiece.**—Unscrew the firing lever and safety catch axis pins and remove the firing lever with pawl and safety catch and piston with spring; lift out the trigger bar lever.

(v) **Roller:**—Take out the split pin No. 2 (brass), or drive out the keeper pin No. 1 (steel), from the collar, and remove the collar and roller.

(vi) **Tangent sight.**—Unscrew the upper graduated plate screw from the stem and remove the slide. Unscrew lower graduated plate screw and remove the graduated plate.

Mk. 2 Slide:**—Take out the split pin from the side screw, unscrew the clamping nut and remove the right hand portion of the slide, washer and pinion.

Mk. 3. Slide.—Remove press cap screw, cap and spring washer, screw fixing drum, drum, ratchet, pinion and spring.

(vii) **Sliding shutter:**—Hold the shutter in a viece, drive out the catch pin with a drift, withdraw the drift and at the same time support the catch to prevent it from flying out; then remove the catch with spring and plunger.

(viii) **Crank group:**—Unscrew crank handle fixing pin, support inside face of the crank handle close to the axis, and drive out the crank by means of a brass drift. Remove the side plate. Drive out the crank pin fixing pin and remove the crank pin.

ASSEMBLING

Reverse the foregoing sequence of stripping taking special note of the following points:—

(i) **Feed-block:**—Ensure that the top and bottom levers are assembled in correct co-relation and that the stud on the bottom lever is in the correct position to engage in the recess in the left side plate when assembling the gun.

(ii) **Lock:**—Assemble the lockspring last, and before doing so ensure that the firing pin is forward and the tail of the tumbler downwards. This ensures that the long arm of the lock spring engages behind the projection on the top of the firing pin.

(iii) **Rear crosspiece:**—Ensure that the pawl of the firing lever is engaged in its recess in the trigger bar lever.

(iv) **Steam tube:**—In assembling the steam tube to the gun, place gun in the vertical position, muzzle end up, as in stripping and ensure that acorn end finds its seating in the trunnion block.

(v) **Barrel:**—The bullet lead on the breech face must be to the top.

(vi) **Sliding shutter:**—The sliding shutter should be open when assembling the lock.

ACTION OF MECHANISM

Loading:—

(i) Open the sliding shutter.

(ii) Insert belt into feed block from right to left until the left hand can grasp the tongue of the belt.

(iii) Pull crank handle onto roller, at the same time giving the belt a sharp tug to the left and slightly forward. Release crank handle. The first round in the belt is now positioned against the cartridge and bullet stops in the feed block, so that the rim is engaged in the extractor ready to be withdrawn from the belt.

(iv) Repeat action as in para (iii). The gun is now fully loaded with one round in the chamber and another in the feed block gripped by the extractor ready for withdrawal. The gun is also cocked and ready for firing.

Firing action (first shot.):—The safety catch being raised and the thumbpiece on the firing lever pressed, the pawl near the bottom of the firing lever pushes forward the bottom of the trigger bar lever which, being pivoted in the centre, causes the top to come to the rear, engaging the projection on the rear end of the trigger bar and drawing it to the rear. As the trigger bar is drawn back the front end of the slot engages the rail of the trigger thereby releasing the nose of the trigger from the bent of the tumbler. The long arm of the lock spring then propels the firing pin forward onto the cap of the cartridge and fires the round.

Action on recoil:—The explosion will cause the recoiling portions to move backwards through a distance of about one inch, thereby extending the fusee spring.

The backward movement is due partly to recoil and partly to the action of the gases which act as follows.

The powder gases which escape through the muzzle after the exit of the bullet, strike violently against the front cone of the muzzle attachment, and rebound onto the front face of the muzzle cup, thereby assisting to drive the recoiling portions to the rear. The gases then escape through the vents in the outer casing of the muzzle attachment.

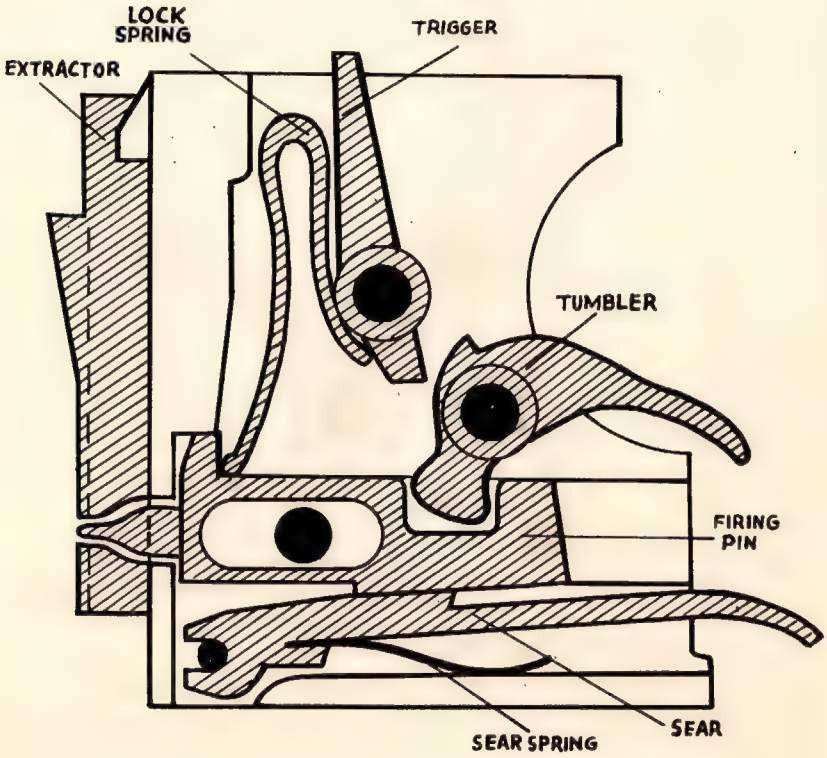
First action in the feed block:—As the recoiling portions travel backwards the recess in the prolongation of the left side plate carries with it the stud on the bottom lever of the feed block. The bottom lever, being engaged with the top lever, causes the slide and top pawls to move to the right, enabling the top pawls to engage behind the round already held in position by the bottom pawls.

Backward rotation of the crank:—During the first tenth of an inch of recoil the barrel, side plates, crank and lock move backward together. Then the tail of the crank handle coming into contact with the roller causes the crank handle and crank to rotate, withdrawing the lock from the face of the breech. Until this takes place the breech has remained locked.

As the crank draws back the lock it causes the fusee to wind the fusee chain, thus further extending the fusee spring.

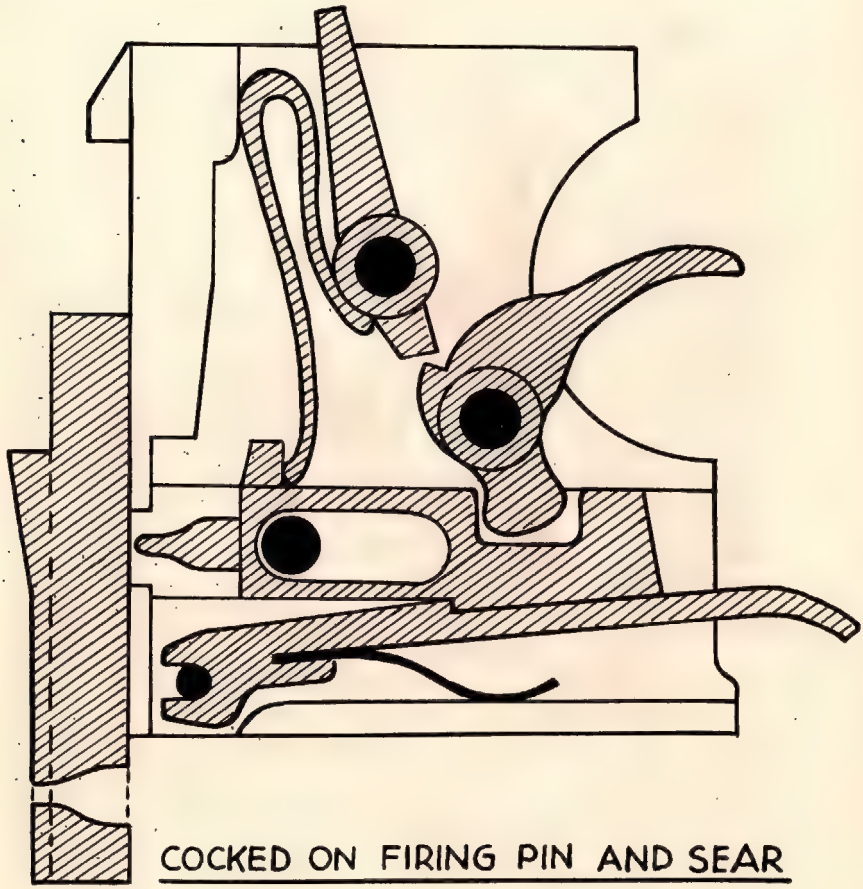
Owing to the momentum of the lock, connecting rod, crank and crank handle, the crank handle continues to roll against the roller. When the second hump on the crank handle comes into contact with the roller, the recoiling portions (side plates and barrel and fusee in crank axis) are forced forward. The crank handle continues to rotate backwards for a further half inch fully

ACTION OF LOCK



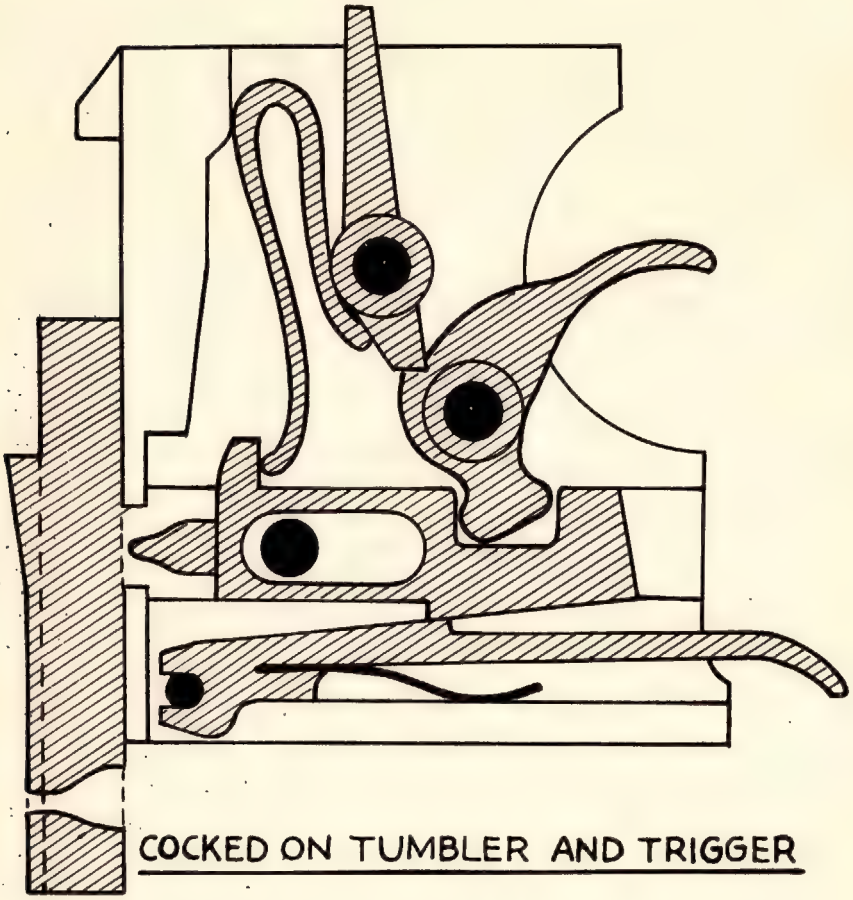
FIRED

ACTION OF LOCK



COCKED ON FIRING PIN AND SEAR

ACTION OF LOCK



COCKED ON TUMBLER AND TRIGGER

withdrawing the lock and allowing the extractors to drop. This action, where the lock is moving backwards while the recoiling portions are moving forwards is known as the "Differential action."

Second action in the feed block:—As the recoiling portions move forward, the recess in the prolongation of the left side plate carries with it the stud on the bottom lever of the feed block. The bottom lever acting on the top lever, moves the slide and top pawls to the left, the pawls thus bringing the cartridge in the belt to a position against the cartridge and bullet stops ready to be gripped by the extractor. The belt, as it moves to the left, slides between the bottom pawls, which are depressed as the cartridge moves other them, rising behind the next cartridge in the belt, holding it in position and preventing it from sliding back after the round gripped by the extractor is withdrawn from the belt.

Backward movement of the lock:—As the lock moves backward, the extractor withdraws the live round from the belt and the empty case from the chamber. The horns of the extractor move along the surface of the cams until the cartridge is clear of the belt. When the extractor arrives at the end of the cams (at the conclusion of the "Differential action") it is forced downwards by the ramps on the cover, thus bringing the cartridge drawn from the feed block, into line with the chamber, and probably causing the empty case to fall off. The live cartridge is prevented from falling off the face of the extractor by the bottom projection of the gib.

Cocking action of the lock:—The rotation of the crank gives an upward motion to the connecting rod and head of side levers. The latter bearing on the tail of the tumbler, rotates the tumbler on its axis, and forces the firing pin to the rear. The long arm of the spring acts on the projection on the firing pin, whilst the short arm bears against the nose of the trigger; consequently the withdrawal of the firing pin compresses the lock spring. As the tumbler further rotates, the short arm of the lock spring forces the nose of the trigger over the bent of the tumbler, and the firing pin is carried still further to the rear, thereby allowing the sear to rise under the influence of its spring, and its bent engages the bent of the firing pin. The lock is now cocked on the sear and firing pin.

Action of the fusee spring:—When the force of the explosion is expended, the extended fusee spring takes command, and unwinding the fusee chain, gives a forward rotary movement to the crank and crank handle. This imparts a forward and downward movement to the connecting rod and side lever head, thereby causing the lock to move forward.

Forward movement of the lock:—As the lock moves forward, the extractor places the live round in the chamber assisted by the bullet guide, and is moved

upwards by the side levers acting on the extractor levers. The bottom projection of the gib slides over the base of the live round in the chamber and the top projection rides over the base of the round which has been moved into position in the feed block. The firing pin hole is thus brought opposite the cap. As the extractor rises ,the empty case, if it has not already fallen off, will be forced off by the seating for ejection.

As soon as the extractor reaches its highest position, the side plate springs engage in the grooves in its sides. (This prevents the horns from falling and fouling the front end of the solid cams in the breech casing at the beginning of the backward movement when there are no cartridges on the ,face of the extractor). The further movement of the connecting rod and side lever head causes the lock to be forced slightly farther forward, and the breech is then closed. The connecting rod and head of the side levers pass just below the horizontal and the force of the downward blow of the crank is taken on the crank stops on each of the side plates.

Firing action (during bursts). The firer, by maintaining pressure on the thumbpiece, holds back the trigger bar; Therefore, each time the lock goes forward, the front end of the slot in the trigger bar, holds back the tail of the trigger before the lock is quite home. By this means the nose of the trigger is prevented from engaging the bent of the tumbler. When the lock is home, the side lever head, as it passes below the horizontal, depresses the tail of the sear, thus allowing the long arm of the lockspring to carry the firing pin on to the cap of the cartridge and fire the charge.

The depression of the sear should be so timed that the firing pin cannot be released until the lock is in the firing position.

Action in lock when pressure on the thumbpiece is released:—On releasing pressure on the thumbpiece the trigger bar is allowed to resume its normal position. The short arm of the lock spring forces the nose of the trigger over the bent of the tumbler, so that, when the sear is depressed, the nose of the trigger engages in the bent of the tumbler and the firing pin is held to the rear. The lock is then cocked on the tumbler and trigger. It is always cocked in this way prior to the first round being fired, and on the sear and firing pin for subsequent rounds during automatic fire.

Unloading:—

(i) Pull crank handle on to roller twice. This will operate the lock while the feed slide remains stationary, and the extractor should now be clear of rounds.

(ii) Depress top and bottom pawls in feed block and withdraw the belt to the right.

(iii) Operate crank handle once more and press the trigger.

Loading for single shots:—Although there is no incorporated mechanism for firing single shots, it is possible to load the gun for such an operation. This method may not be of much use in action as it necessitates the hand operation of the crank handle after each shot, but it is very useful in the case of zeroing.

Proceed as for normal loading except that the PULL ON THE BELT AFTER THE SECOND ACTION OF THE CRANK HANDLE IS OMITTED. This brings one round into the chamber while leaving the empty pocket in the belt opposite the extractor.

PREPARATION OF GUN FOR BLANK FIRING

By the use of certain special components it is possible to use the Vickers Gun in the fully automatic role with blank ammunition.

The components which go to make up the complete blank firing apparatus are as follows:—

Barrel Mk 2 D.P.B.:—Choked at the breech, it is marked "D.P.B." on the trunnion block.

Cup muzzle attachment blank, Mk 1:—Has a large recessed seating to house the head of the adjusting screw, and is assembled to the "D.P.B." barrel in the usual manner.

Plug Screw adjusting muzzle attachment blank:—Has a large concave head drilled longitudinally for approximately one inch and is screwed into the front cone so that the large end may enter the muzzle cup.

Cone front, muzzle attachment blank:—Is recessed, with holes drilled on the periphery, and assembles into the outer casing of the muzzle attachment in place of the ball pattern front cone.

Nut adjusting, muzzle attachment blank:—Is of the ring type with holes in the outside edge to accommodate the spanner. It assembles to the outer end of the adjusting screw and locks against the face of the front cone.

To set the gun up for blank firing assemble the action with the Barrel D.P.B. and the Cup Muzzle Attachment Blank. Screw the Plug into the Cone Muzzle Attachment Blank, and screw the Cone into Outer Casing Muzzle Attachment Ball. Unscrew the Plug until it just commences to force the recoiling portions backwards. It should then be screwed away from the Cup Muzzle Attachment Blank until only just sufficient power is obtained to function the gun with a load of 4½ lbs. on the fusee spring. The Plug should then be locked in position by the Nut. The amount that the Plug should be screwed away from the Muzzle Cup should never be less than one turn.

TESTS, ADJUSTMENTS AND GAUGING

1. **Firing pin hole:**—This should be gauged for size with the "Plug plain, diameter of firing pin hole, .088" High." This is a reject gauge and should not enter firing pin hole in extractor.

2. **Firing pin protrusion:**—Gauged in the normal manner, with the lock in the fired position, using the gauge as issued. Protrusion limits are .058" L, and .065" H.

3. **Overall length of lock:**—As the length of the assembled lock has a considerable effect on cartridge head space, it is necessary that this component should conform to certain limits of size. The overall length of the assembled lock is measured from the face of the extractor to the end of the side lever head and should be between 4.438" L, 4.445" H.

4. **Weight of lock spring:**—With the lock fully cocked on the sear and firing pin, pull upwards on the side lever head with a spring balance. An upward pull of 14 to 16 lbs. should register on the spring balance at the first move of the tail of tumbler.

5. **Gib and gib spring:**—With the lock removed from the gun, apply the rim of the .064" gauge through the extractor grooves. Ensure that it is held firmly by the gib. A dummy cartridge with a minimum rim thickness of .058" should also be held firmly and show no signs of droop.

6. **Serviceability of extractor and extractor levers:**—Strip the lock and reassemble with extractor, extractor levers, and side levers only. With side levers held fully down there should be no sign of "lift" on the extractor. The presence of "lift" denotes wear on the extractor or extractor levers, and new extractor levers should be tried. If the wear is on the bents of the side levers however, the complete lock must be changed as side levers are not issuable separately.

7. **Weight of fusee spring:**—This test should be carried out with the lock removed from the gun. Place the loop of the spring balance over the knob of the crank handle and pull upwards vertically. Initial movement on the crank handle should be obtained with a pull of between 7 lbs and 9 lbs. If the weight does not conform to these limits it can be increased or decreased by adjustment of the screw in the front of the fusee spring box. To increase the weight turn the adjusting screw clockwise (looking from the front of the gun) and anti-clockwise to decrease it. At each half turn the screw will click and the amount of adjustment can be regulated by using the formula "Six clicks or three complete turns = 1 lbs., in either direction."

8. **Crank and crank stops:**—The downward blow of the crank group should be taken on the crank stops on the side plates. To ensure that this is being done remove lock from gun and let crank handle forward slowly. A feeler of 1½ thousandths thickness (or a piece of tissue paper) should be gripped between the crank and crank stops. At the same time there should be a clearance between the crank handle and the check lever, and between the tail of the crank handle and the roller, thus ensuring that

none of the shock is being taken on these components. The clearance between the crank handle and the check lever should be .005 ins or "note-paper clearance" and the same clearance should be obtained between the tail of the crank handle and the roller. If these clearances are insufficient they should be adjusted by removing metal from the check lever and the tail of the crank handle respectively. The front of the crank handle and the roller must never be filed.

9. **Tightness of packing:**—To ensure correct functioning it is necessary that the asbestos packing, while sealing the barrel casing against leakage, does not seriously impede the recoiling portions during firing. A test is therefore carried out to ensure that the pull needed to draw the recoiling portions back (without the influence of the fusee spring) is reduced to a minimum. Remove the fusee and fusee spring, and also the lock. Lift the crank handle into the vertical position, place the loop of the spring balance over the boss of the crank axis and pull back. The weight required to move the recoiling portions should not exceed 4 lbs., (in the case of blank ammunition it should not exceed 2 lbs.). If the weight is excessive, work the recoiling portions backwards and forwards by hand until weight is reduced. If gun has been newly packed it is advisable to leave the pull at 6 lbs., and let the working of the gun reduce it to 4 lbs.

10. **Cartridge head space:**—To carry out this test the following are necessary:—

Gauges Armr's .064" No. 1 . 1	
Washers adjusting connecting rod No. 1 (.003") . .	As available
Washers adjusting connecting rod No. 2 (.005") . .	

Remove the fusee spring. Strip the lock and reassemble it with extractors, extractor levers and side levers only. Place a No. 1. Washer on the connecting rod and re-insert the lock. Guide a .064" gauge into the extractor slot until it is over the firing pin hole, then allow the crank handle to go forward slowly, guiding the gauge into the chamber. A slight check should be felt as the crank handle comes to rest. If there is no check add Washers No. 1 or No. 2 as required until check is felt. Now remove the last No. 1. Washer fitted and assemble the remaining washers between the nut adjusting and the collar of the connecting rod, and tighten the nut. The cartridge head space is now correct. A maximum of 3 No. 2 Washers is allowed, if more are required, test with a spare lock or new Nuts adjusting.

11. **Height of extractors:**—Assemble the gun complete less the feed block. Pull crank handle on to roller and allow it to fly forward under the influence of the fusee spring. The clearance between head of extractors and underside of the stop on front cover should not exceed .005" (.008"

in war). If this clearance is exceeded it should be re-checked using the spare lock. If it is then correct the gun lock should be exchanged or the extractor levers changed until it also is correct. If with the space lock the clearance is still excessive a new front cover should be tried.

12. **Timing of sear release:**—If the tail of the sear is bent upwards, it will allow the side lever head to release the sear from the firing pin prematurely and cause the firing pin to foul the back of the extractor. To test the gun to see that the sear is being released correctly, open the front cover and remove the feed block; pull crank handle on to roller. With the left hand depress the firing lever and with the right hand take crank handle forward slowly. A distinct click will be heard when the sear is released and it should be observed if any further upward movement on the extractor is possible after the sear is released, denotes a distorted sear.

13. **Trigger and safety catch:**—Ensure that there is not too much lift to the safety catch thus preventing the firing lever from going far enough forward to fire. When trigger is released a further forward movement of at least .02 ins., should be possible on the firing lever.

14. **Freedom of steam tube:**—Elevate and depress the gun several times and listen for the sleeve of the steam tube sliding on the tube. If it is not free, water will be able to leak through one of the steam holes when the gun is either elevated or depressed.

15. **Alignment of exit hole in muzzle attachment with bore of barrel:**—The "Plug, long, special diameter .301 ins" with sleeve is inserted in the cone until the plug portion enters the barrel. In this position the sleeve should enter the hole in the cone without obstruction.

16. **Barrels:**—If the chamber or bore appear to be worn, an accuracy test should be carried out. The conditions for this test will be found in S.A.T. Volume 1, Pamphlet 1, Appx. 1. At 400 yds, ten deliberately aimed shots should fall in a scribed square of 24 ins sides. Barrels failing this test should be returned to C.I.S.A. with results of test recorded on AF B 202.

    In the event of the gun being required for overhead fire, or for use in battle-inoculation practices, a stricter gauging of the barrel is necessary. Barrels for use in these roles will be gauged with a .306 in. plug gauge, which must not enter from the breech end more than 3.5 ins. EMER, SA and MG E, 503, page 3, shows a table giving the probable remaining life of a barrel (in rounds) at various measurements of the gauge.

17. **Barrel casing:**—In the event of the barrel casing becoming punctured the gunner can effect a temporary repair by means of the "Patches, First aid, Vickers MG, Mk 1" which he carries in his accessories.

    A permanent repair will subsequently by carried out, by sweating over the puncture a patch of sheet tin about .02 ins. thick.

GUNS M/C VICKERS .303 in. Mk 1

Regulations affecting the above equipments

EMERs

EMER E 503	page 1 to 2	Maintenance of Locks.
	page 3 to 4	Examination and gauging of barrels.
	page 5 to 6	Testing of barrel guide.
	page 7	Fitting of Mk. 2. Extractors to Mk. 1. Locks.

EMER E 507	Mod. Instr. No. 1	List of Modification Instructions issued from 1st Jan. 1946 to 23rd Oct. 1946.
E 507	Misc. Instr. No. 1	Marking of Barrels with letters S.C. to indicate Modification.

21 AG EMER E 934 page 1 Extra gauging.

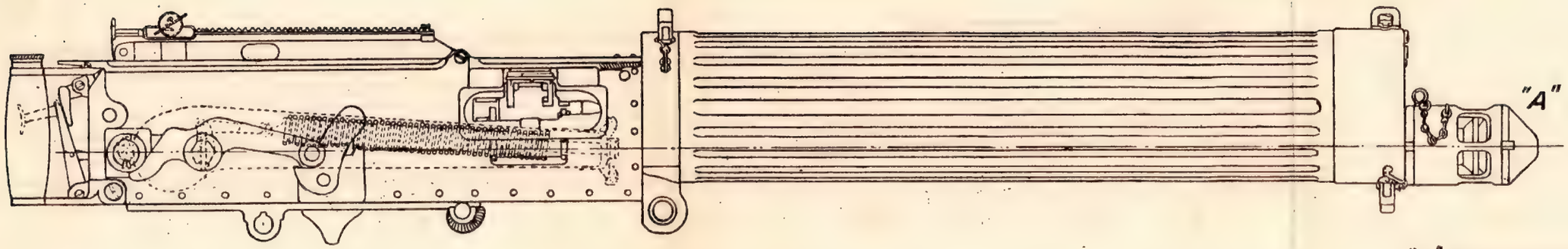
ARMY COUNCIL INSTRUCTIONS

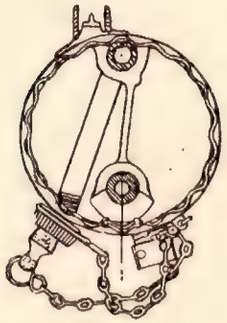
ACI No. 653	1941	Issue of Covers Barrel Casing.
2302	„	Fixing of Backsight (.30").
1714	1942	Interchanging of various components.
1814	„	Plugs screwed.
2539	„	Boxes dial sight Mk. 2.
1459	„	Barrels-use of Mk 8z ammunition.
2501	„	Locks breech Mk 2.
926	„	Cans condenser steam.
108	1943	Belt-hand-filling, 250 rounds stripless. Introduction.
560	„	Box dial sight Mk 2. Sand proofing.
773	„	Mk 8z ammunition. Life of barrels.
373	1944	Mk 8z ammunition. Life of barrels.
1162	„	Bullets jammed in bore. Use of clearing round.
1114	„	Use of gauge plug, .306".
1170	„	Stoppages due to pierced caps.
81	1945	Tubed barrels not to be used for operational purposes.
202	„	Barrel life.

21 AG and Rhine Army Technical Bulletins

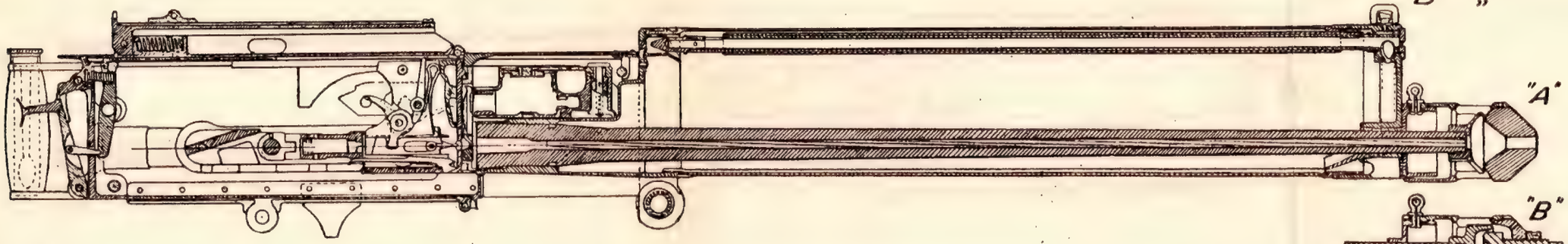
SA & MG paras 5 and 150	Shearing of check lever brackets.
„ 19	Assessing life of barrels.
„ 36	Extractors interchangeable. Checking of tubed barrels.
„ 36 and 150	Leaks in barrel casing.
„ 54 and 150	Fractures to claws and other damage to front covers.
„ 54, 74 and 150	Unscrewing of front end cap. Elevating stop makes contact with steel type crosshead.
„ 104 and 109	Issue of Extractors Mk 2 (Tank pattern).

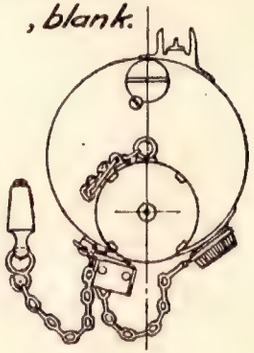
ARMOURERS WING
PRECIS No. SA/32

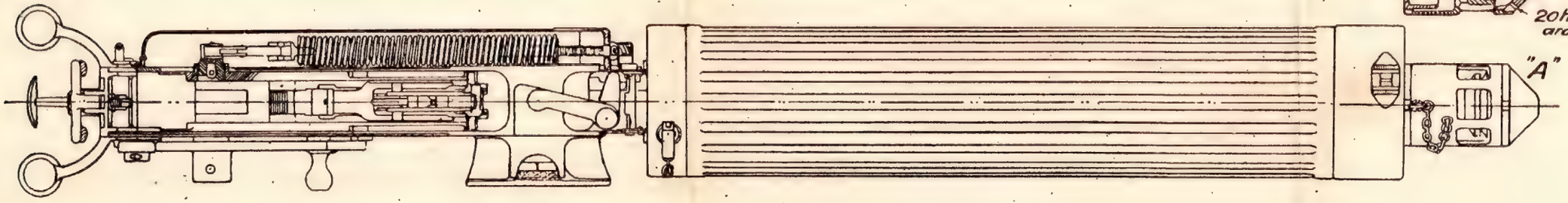




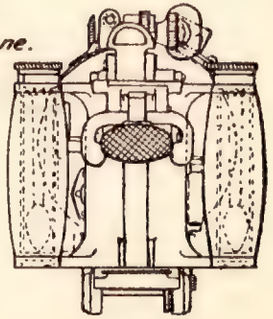
"A" Muzzle-attachment, ball.
"B" " " , blank.







20 holes around cone.



VARIOUS MARKS ON MACHINE GUN BARRELS

Mark	Where Found	Meaning
T.	On the Breech Face.	Barrel re-tubed under a special process.
MK. 1 or MK. 2.	On the Trunnion Block.	Denotes the Mark of the Barrel.
D.P.B.	On the Trunnion Block.	Denotes a Blank Firing Barrel.
A Band of White Paint.	Round the centre of the Barrel.	Denotes a Mobilisation Barrel.
D.P.	On the Trunnion Block.	For Drill Purposes Only.
7.	On the Trunnion Block.	Barrel has fired Mk 7 ammunition and must NOT be used to fire Mk. 82.

MOUNTINGS TRIPOD VICKERS .303" MG.

(Incorporating Clino. Vickers)

GENERAL INFORMATION

This mounting is a heavy static type. The gun is carried on a crosshead which pivots in a vertical socket. Thus the gun can be fired on free traverse or, with the crosshead locked in the socket, set for fixed line firing.

The standard pattern, which is known as the Mk 4 B weighs 56 lbs, while the war time equivalent which is constructed of a light alloy metal is considerably lighter and became the Mk 5 which is now obsolete.

The tripod has a maximum elevation of 13 degrees and a maximum depression of 25 degrees, when Gun Axis is Parallel to Ground at a height between 14.5" and 30" by Moving Lees, a maximum of 43° E. and 55° D. can be obtained.

STRIPPING

Elevating gear

1. Remove the split pin from the "T" head of the inner elevating screw to disconnect the chain.
2. Unscrew the tumbler nut. Lift out the inner and outer elevating screws with the elevating nut.
3. Unscrew the elevating wheel nut.
4. Remove the elevating wheel.
5. Remove the feather from the elevating wheel bush.
6. Unscrew and remove the jamming bolt with nut and pointer.
7. Remove the elevating wheel bush by pressing it upwards, ensuring that the keyways in the collar coincide with the keys in the tumbler.
8. If not already marked, lightly mark the tumbler pins and the sides of the crosshead arms as a guide for subsequent replacement. Remove the split pins, lever out the tumbler pins and lift out the tumbler.

Crosshead

1. Slacken the traverse check clamp screw to its full extent and lift out the crosshead from the socket.

Dial direction

1. Slacken the three set screws and lift off the dial from the socket.

Legs front

1. Remove the keep pin, unscrew the stop nut and jamming handle and remove the spring disc and leg from the stud joint.

Legs rear

1. Drive out the keep pin from the jamming nut and unscrew the nut. Drive out the joint pin and remove the leg.

NOTE:—The clutch plates on the socket are not interchangeable and should not be removed.

ASSEMBLING

To assemble the mounting, reverse the foregoing order of stripping paying special attention to the following details:—

Handles jamming

Ensure that the handles for the front legs are upward and 25 degrees beyond the vertical when fully tightened (Right leg, handle forward. Left leg handle backward) and that the legs are in the position marked "20" in relation to the clutch plates marking of "O".

Screws elevating

If the gun is to be mounted to the tripod a certain adjustment is necessary on the elevating screws to ensure that the gun will receive its maximum movement during elevation and depression. With the outer elevating screw flush with the top of the tumbler nut, the inner elevating screw should be approximately six turns out from the outer screw.

ACTION OF MECHANISM

To fully appreciate the action of the elevating gear the following information regarding the elevating screws must be understood:—

Screws elevating, inner. . .	Threaded externally with a right hand thread.
Screws elevating, outer. . .	Threaded both internally (right hand) and externally (left hand).
Nuts elevating.	Threaded internally with a left hand thread.

On rotating the wheel elevating the bush wheel elevating is also rotated as it is keyed to the wheel. The bush is in turn keyed to the outer elevating screw by feather and groove. This groove, being cut the full length of the outer screw, gives the screw full, free movement up and down during elevation and depression.

The elevating nut, being keyed to the tumbler, cannot rotate. Therefore, as the elevating wheel is turned, the outer elevating screw, being rotated by the bush is screwed into or out of the elevating nut.

The inner elevating screw is screwed inside the outer screw with a lug on its upper end for attachment to the gun. Being attached to the gun, the inner elevating screw is also prevented from rotating so that it is forced to move into or out of the outer elevating screw during the rotation of the latter.

It will be seen, therefore, that an elevating or depressing motion is imparted to the gun through both the elevating screws.

TESTS, ADJUSTMENTS AND GAUGING

1. The numbers on the crosshead and socket must agree.

2. **Handles jamming:**—Assuming that adjustment as detailed under "ASSEMBLING" to be correct, loosen the jamming handles front leg, against the nuts clamping. It should be ensured that the handles do not fall too low and therefore be liable to distortion when the tripod is thrown onto the ground during action or "Elementary Gun Drill." If the movement is excessive it can be adjusted as follows:—

   File back the shoulder of the stud against which the nut seats and fit washer, stud, joint front leg. These washers are issued in two sizes, No. 1 being $^1/_{64}$th inches thick and No. 2 being $^1/_{16}$th inches thick.

   Ensure that the front leg jamming handles do not foul the crosshead during its rotation.

   The position of the handle jamming rear leg should be approximately in alignment with the leg when fully tightened. Errors in this case may be adjusted either by changing the starting position on the screw thread of the stud, or by making and fitting a washer or filing the face of the nut. If these methods give insufficient adjustment, an additional keyway may be cut in the leg joint or a new key fitted to the joint pin. These should not be less than 60° from the old key or keyway.

3. **Crosshead:**—Assemble the gun to the mounting by the front joint pin only, test for lateral play of gun between the jaws of the crosshead. If the gun stop does not seat on the cross web of the crosshead a stop should be fitted. This is to prevent the fusee box from fouling the crosshead. The distance from the top of the front joint pin hole to the top of the crosshead jaw

should be .45 ins., to allow for the correct centring of the gun. If this is less than .45 ins., a dovetail piece will be sweated into the crosshead jaw filed down to make the distance .50 ins. This allows for subsequent wear. Details and drawings of both these modifications will be found in "Instructions for Armourers 1931, Chapter 4, Section 4."

4. **Elevating gear:**—Play in the elevating gear may be taken up by the fitting of new elevating screws (inner and outer), or by the fitting of washers between the elevating nut and the tumbler, according to the location of the play.

NOTE:—If play is found between the elevating screw inner and outer, BOTH screws must be exchanged.

CLINOMETER VICKERS .303"

The Clinometer Vickers is used by the gunner to lay the gun for overhead or indirect fire, and by Armourers to test for wear in the Gun and for wear or incorrect adjustment of the elevating gear of the mounting.

Examination

1. Ensure that the bubble is not broken or loose.
2. Ensure that the spindle does not bind, that the spring is not weak and that the segment is free on the cradle.
3. Ensure that the base is rigidly fixed to the cradle and that the bearing surface of the base is true and free of all burrs.

Tests and Adjustments

Backlash

1. Place the Clinometer on a flat and approximately horizontal surface. The cover of a Gun M/C Vickers may be used with the gun mounted on the tripod.
2. Set a five degree depression reading on the Clinometer and then bring the bubble central. Note the reading.
3. Repeat the above from five degrees elevation again noting the reading.
4. The two readings obtained should not differ by more than two minutes. If the difference is greater see that the worm spindle bearing is held firmly by the pivot screw and that the worm spindle spring it not weak.

End for End Test

1. Set the Clinometer to read zero.
2. Place the instrument on the gun with the arrow pointing to the front.
3. Centre the bubble by the elevating handwheel.
4. Reverse the instrument. If the bubble is not level, bring it to the centre by using the adjusting head of the instrument. Observe the error denoted by the reading on the minute scale.
5. Now halve the error, e.g., if the error is ten minutes depression turn the adjusting head until the reading is only five minutes depression.
6. Now reverse the clinometer again so that the arrow is pointing to the front and centre the bubble by means of the elevating gear of the tripod.
7. Now reverse the instrument and the bubble should be central. If it is not central re-test by starting at 1.
8. If No. 7 proves correct take the instrument and loosen the locking nuts of the minute scales one at a time. Take special care not to alter the adjusting head. Turn the minute scales to zero and clamp up. Also zero the pointer of the degree reader by loosening the two screws.

Testing the Tripod with the Clinometer

Ten minutes of angle test

1. Assemble the gun to the mounting, set the clinometer to read zero and place it on the breech casing.
2. Lift gently under the rear crosspiece thereby taking up any play in the elevating gear of the tripod. Bring the bubble central by means of the elevating handwheel of the tripod.
3. Release the upward pressure on the gun and exert similar pressure downwards on the rear crosspiece. If the bubble is now out of centre bring it central by means of the adjusting head of the instrument.
4. Take the reading on the clinometer. This should not exceed 10 min. If the error is greater and the clinometer has passed the previous tests, examine the tripod for wear in the elevating gear etc.

Elevation and Depression Test

1. Set the legs of the mounting at zero.
2. Set the elevating screws of the mounting so that with the outer screw flush with the tumber nut, the inner screw is six turns out. Assemble the gun to the mounting.
3. Zero the Clinometer and place it on the gun. Bring the bubble central by means of the elevating handwheel.
4. Set the Clinometer to read 13 degrees elevation and elevate the gun by means of the handwheel to centre the bubble. The amount of elevation necessary for this should be obtained before the stops of the gun and mounting make contact.
5. Set the Clinometer to read 20 degrees depression. Bring the bubble central by means of the elevating handwheel. The additional 5 degrees depression needed must be obtained by rotating the handwheel a further 1¼ turns. If 25 degrees of depression cannot be obtained see that the outer screw of the elevating gear does not foul the web of the crosshead.

NOTE:—TO TEST FOR WEAR IN MOUNTINGS TRIPOD .303" M.G., THE GUN USED SHOULD BE IN GOOD CONDITION AS REGARDS WEAR IN THE JOINT PIN HOLES.

ARMY COUNCIL INSTRUCTIONS

Para	*Date*	*Detail*
2043	1942	Mountings Mk 4 "B."

ARMOURERS' WING
Précis No. SA/33

E.M.E. REGS.

S.A. and M.G.

21 ARMY GROUP AND RHINE ARMY TECHNICAL BULLETINS

(Not an Authority. For Guidance Only)

S.A. and M.G.

Para	*Detail*
54 150	Elevating Stop makes contact with the steel type Crosshead.

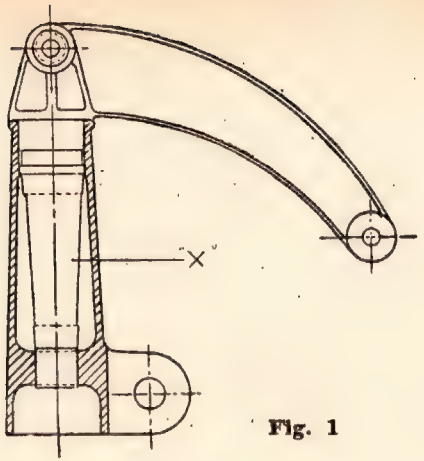
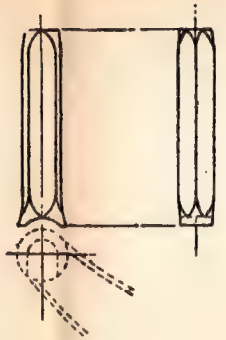


Fig. 1



Punch A

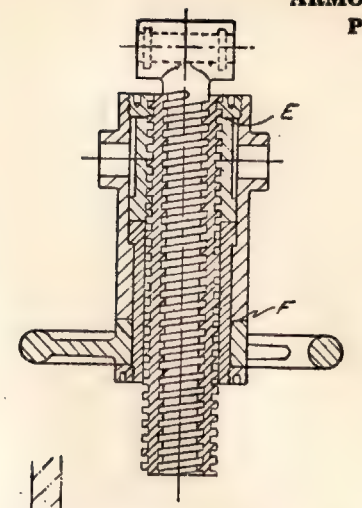


Fig. 2

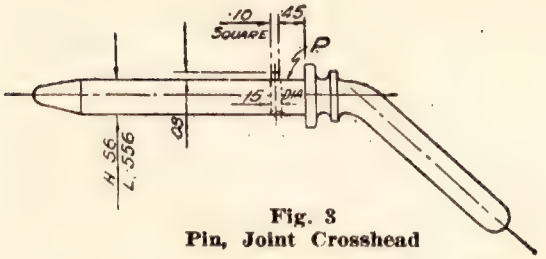


Fig. 3
Pin, Joint Crosshead

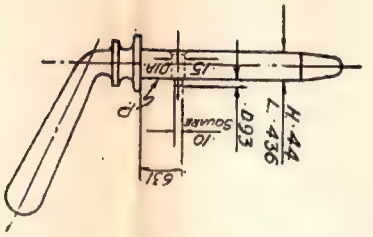
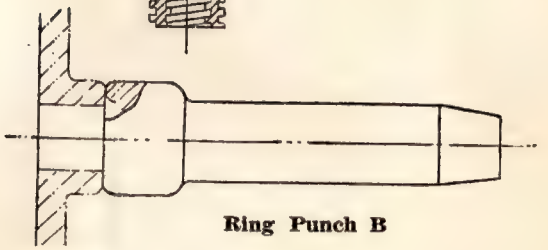


Fig. 4
Pin, Joint, Elevating Gear



Ring Punch B

CROSSHEAD:— When play occurs between the Gun and the Mounting at the pin joint, the jaws can be set inwards by means of a raw hide mallet or by carefully nipping the Crosshead in a vice. Care must be taken to set each jaw equally, and to see that a Crosshead Joint Pin of maximum size (.56) will pass through freely after such adjustment. When wear is such as to produce play between the Crosshead Pivot and the Socket bearings it can be taken up by setting the Pivot between the bearings, at "X" (See Fig. 1), or by tinning the bearing surface of the Pivot.

Should the bearings for the Tumbler trunnions be large, they can be swaged inwards with punch (A), care being taken to ensure a good bearing. As wear is in a downward direction it will usually be found sufficient to swage the lower portion of the bearing. After swaging it is necessary to make certain that the tumbler trunnions will freely enter the bearings.

ELEVATING GEAR:— End play of the Elevating Nut can be taken up by inserting at "E" (See Fig. 2) one or more of the packing washers provided, but steps should first be taken to ensure that the Tumbler Nut is screwed home.

When the axis pin holes in the Tumbler trunnions are worn, the trunnions can be swaged inwards by means of Ring Punch (B). When there is an appreciable amount of end play between the Handwheel and the Tumbler, and it is not possible to further tighten the Handwheel Nut, the play can be taken up, either by prolonging the screw thread on the Handwheel Bush, by filling, so allowing the Handwheel Nut to be screwed further on, or by inserting a suitable washer between the Handwheel and the Tumbler at "F" (See Fig. 2.).

PINS, JOINT CROSSHEAD, AND ELEVATING GEAR:— When badly worn they are to be replaced by new ones, usually they only require a new feather (See Figs. 3 and 4) when fitting this care should be taken not to reduce the diameter at "P".

NOTES:—

(a) The Elevating Gear as a whole can be tightened by screwing up the Jamming Bolt on the Tumbler, care being taken that the gear does not jam. If the jaws are permanently closed they are to be opened out by means of a wedge and eased where necessary.

(b) When the Elevating Screws or Nut are so worn as to produce lateral and vertical play such as would be detrimental to the use of the Mounting for overhead fire they will be exchanged, such exchange will be made as an assembled unit consisting of the inner and outer screws and the elevating nut. Should the new unit be a loose fit in the Tumbler, on diameter, owing to the latter being worn, the elevating nut may be tinned externally, so as to ensure a "press fit". A non-rusting flux must be employed when tinning.

PACKING, STORAGE, PRESERVATION AND LUBRICATION

Packing

Special attention must always be paid to the packing of Small Arms and Machine Guns, whether for storage or transit. Approved cases and chests are usually available on demand and certain of these contain all the necessary equipment i.e. battens, supports etc.

The V.A.O.S. Sections, in which will be found the chests available for certain types of Small Arms and Machine Guns, are listed below:—

Section B. 2. Chests for Rifles Nos. 1, 2, 3, 4 (T), Swords Bayonets and Scabbards, Lances and Barrels and Bodies of Rifles No. 1. Also CASES S.A. for S.A. and Components.

Section C. 1. Chests for Gun M/c Vickers Mk 1, Lewis, Bren and Barrels of these guns.

Section C. 2. Chests for Guns M/c Besa, Vickers Mk 4 to 7, and Vickers .5" Mk 5.

Detailed instructions for the packing of Rifles No. 1, 2, 3, Bayonets and Scabbards will be found in Instructions for Armourers 1931, Appx. 4. No. special instructions should be necessary for the packing of Machine Guns in their authorised chests.

If it is necessary to pack any Small Arms for which there are no authorised chests, or for which the approved pattern chests cannot be obtained knowledge of the information given in the above mentioned Appendix of Instructions for Armourers, together with that contained in Equipment Regulations 1942, part 1 paras 159 to 171 and Appx. I4, will be a sufficient guide.

The packing of Small Arms is especially important when they are in transit. The main consideration which should guide all packing of Small Arms is the prevention of damage.

Storage

Small Arms and Machine Guns are normally stored in approved chests or racks, but it may be necessary to store rifles when neither of these is available. In this case the rifles should be stacked in layers in accordance with the following procedure, the authority for which is contained in R.A.O.S. Part I, Appendix 46, which reads as follows:—

Material required for each stack

Timber, scantling, 4 ft. × 4 ins. × 2 ins.	4 pieces
Strips, wood, 4 ft. × 1 ins. × 1/4 ins.	81 „
„ „ 4 ft. × 1 ins. × 1/2 ins.	78 „

1. Lay the four pieces of scantling parallel to each other on the floor and parallel with the stacker with the following distances between each piece:— (the four pieces have been numbered 1 to 4—No. 1 being nearest to the stacker throughout.)

First and second — 6½ ins apart.
Second and third — 12 ins apart.
Third and fourth — 6½ ins apart.

2. Place a quarter inch strip along the top lengthwise and exactly in the middle of each piece of scantling, except No. 2.

3. Put down the first layer of ten rifles with butt towards the stacker keeping the knob of the bolts uppermost. The butts of rifles should project over the first piece of scantling towards the stacker about 2 ins.

4. Dress the rifles with straightedge from the stacking side. The position of the rifles on the scantling should now be a follows:—

First piece (on ¼ ins. strip) — Just above butt swivel.

Second piece (without strip) — On thick of fore end between knob of bolt and bridge.

Third piece (on ¼ ins. strip) — Just below lower band swivel.

Fourth piece (on ¼ ins. strip) — On cap nose just above piling swivel.

It is most important that these first ten rifles be accurately stacked in accordance with the above instructions.

5. Now place a half inch strip across the first layer of rifles lengthwise and exactly over the middle line of Nos, 1 and 4 pieces of scantling, and a quarter inch strip lengthwise and exactly over middle line of Nos. 2 and 3 pieces of scantling.

6. On these lay the next ten rifles with muzzles towards the stacker, the bayonet standard being in line with the heel of the butt of the rifles underneath it.

Dress with a straightedge to the level of the butts on the first layer.

7. Repeat instructions 5 and 6, alternating butts and muzzles towards the stacker.

Special attention should always be paid to any wrappings used in the storing or packing of Small Arms. The use of materials as wrappings which tend to absorb moisture should be avoided. Greaseproof paper is naturally the best wrapping if it is available.

Bicycles to be kept in store should always be stored without their tyres and tubes. (Equipment Regulations, Part I, 1942, para. 261.)

Preservation and Lubrication

The authorised preservatives and lubricants for use with Small Arms and Machine Guns may change from time to time. Armourers should therefore keep themselves acquainted with current issues of A.C.Is., E.M.E. Regs. etc., and watch for modifications or additions.

The following copies of E.M.E. Regulations give complete instructions on the Preservation and Lubrication of Small Arms and Machine Guns:—

E.M.E. Regulation, S.A. and M.G.A. 131, page 1

1. (a) Table I lists the lubricants which are suitable for use in Small Arms and Machine Guns, etc., at various degrees of temperature.
   (b) Table 2 shows source of supply of lubricants for use with Small Arms and Machine Guns, other than 20 mm.

2. An overlap of 5° Fahrenheit between the temperature ranges should not be exceeded before the necessary changes of lubricants are made .

3. Where emergency substitutes are quoted in the tables, these should only be used if the correct lubricant is not available. In such cases the parts concerned should, where possible, be kept under special observation as more fequent servicing may be necessary.

4. In the event of kerosene vapourizing oil being unobtainable, kerosene burning oil may be used. When either of these oils are used, neat lubrication of weapons must be reverted to at the first opportunity, as both oils are detrimental to preservation against rust.

5. At temperatures of 40° Fahrenheit and below, particular attention will be paid to the following points:—

(a) Mechanisms will be stripped, wiped clean and lubricated in accordance with Table 1.

(b) Ensure that firing pins, strikers and their springs are free in their housings, as these may freeze, although other parts of the mechanism work freely.

(c) Mechanisms which are not stripped during normal maintenance, such as elevating gears, will be thoroughly rinsed with petrol, allowed to dry and then lubricated in accordance with Table 1.

6. The following precautions will be taken with water-cooled guns when hard frosts are experienced:—

(a) When lubrication is being carried out, barrel packings which have been lubricated with oil other than that specified in Table 1 for temperatures below 40° Fahrenheit, will be replaced by packings correctly lubricated.

(b) The weight of the fusee spring on Guns, machine, Vickers, .303" Mk 1 will be reduced to 7 lbs.

(c) Barrel casings will be emptied and refilled with water diluted with thirty per cent glycerine, glycerine residue or glycol. When it is necessary for the solution to be topped up, water will be added when glycerine or glycerine residue has been used, but glycol and water will be added in the correct proportions when glycol has been used. Care must be taken not to exceed the thirty per cent solution of glycol has been used. Care must be taken not to exceed the thirty per cent solution of glycol as a stronger solution gives off harmful fumes. In temperatures below minus 40° Fahrenheit, a solution of fifty per cent glycerine or glycerine residue will be used. Glycol will NOT be used in these temperatures.

7. When equipments are held in store or are not likely to be used for a long time they will be greased with Grease, G.S. or preservative, mineral jelly and beeswax (H.A. 6627). Barrel casings of Vickers or other watercooled M.Gs. will be emptied, dried, rinsed out with Oil A., and drained before being stored.

8. All equipments which are to be involved in landing operations will be smeared with Grease No. 0 or, in emergency Grease G.S., thinly applied. Equipment which will be needed for immediate use on landing will be smeared cn the outside only, the internal working parts being lubricated as detailed in Table 1. The earliest opportunity will be taken of wiping dry and re-lubricating.

9. At extremely low temperatures springs become brittle. The scale of issue of springs for Small Arms and Machine Guns will be increased by fifty per cent, when they are subjected to these conditions.

Table 1:—Lubricants suitable for use

Weapon	Temperature range	Approved lubricant	Spec. No.	Cat. No.	Emergency substitute
Gun M/c Bren, .303"		grease	CS 1420	HA 6009 } HA 6015 } HA 6017 }	
Gun M/c Besa, 7.92 mm		XG 340	CS 881 CS 1819		Mixture 80% Grease G.S. 20% Hypoid 90
All Small Arms and M.Gs. other than Bren and Besa	Over 80° F.	Oil A, or Oil, OX-13.	CS 906 CS 1721	HA 0119 HA 5592 } HA 5583 }	
			CS 1020	HA 0145	Oil, M 80
All S.A. and M.G.	Between 40° F. and 80° F.	Oil A, or Oil, low test cold No. 2 LG 380	CS 906 CS 1721	HA 0119 HA 5592 } HA 5583 }	
			CS 1020	HA 0145	Oil, M 80
All S.A. and M.G.	Between 0° F. and 40° F.	Oil, low cold test No. 2 or Grease No. 0	CS 1721 CS 1879	HA 5592 HA 5583	
All S.A. and M.G.	Below 0° F.	50/50 mixture of Oil low cold test No. 2. and Kerosene, vapourising or	CS 1721		Kerosene burning for Kerosene vapouring
		50/50 mixture Grease No. 0. and Kerosene vapourising	CS 1879		dito

Table 2:—Source or Supply of lubricants

Nonnenclature	Section H 1	Source
Oil A	HA 0119	R.A.O.C.
Oil, low cold test, No. 2	HA 5592	
	HA 5583	R.A.O.C.
Graphited grease (RD 1179)	HA 6009	R.A.O.C.
	HA 6015	
	HA 6017	
Oil M. 80	HA 0145	R.A.O.C.
Grease G.S.		R.A.S.C.
Grease No. 0		R.A.S.C.
Hypoid 90		R.A.S.C.
Oil, kerosene, vapourising		R.A.S.C.
Oil, kerosene burning		R.A.S.C.
Preservative, mineral jelly and beeswax	HA 6627	R.A.O.C.

When bicycles are kept in store, bearings will be kept well packed with a mixture of equal parts, by weight, of mineral jelly red, and Oil "A", (M 80). Bicycles in use will have their bearings stripped and cleaned at least once a year, and re-packed with this mixture. Maintenance lubrication of the bearings of bicycles in use, will be carried out with Oil "A" (M 80).

Covers and tubes of bicycles kept in store will be stored as follows:—

Covers:—Will be loosely tied in bundles of ten or less and kept in cool and darkened store, according to their respective dates of manufacture.

Tubes:—Will be stored in order of date of manufacture. They will be deflated and placed loosely in a case; the case will be lined with brown paper, the tubes liberally covered with french chalk and the lid of the case secured. The case will be periodically reversed (bottom upwards) to ensure that the bottom layers do not continuously bear the weight of the others.

A complete turnover and examination of covers and tubes will take place annually. (Equipment Regs. Part 1, 1942, para 261.)

The preservation and lubrication of 20 mm gun equipment differ in some particulars from that of Small Arms and Machine Guns. The following is a copy of the E.M.E. Regulation dealing with this subject:—

E.M.E. Regulation, S.A. and M.G.F 033, page 1.

1. **Items affected:—**

20 mm machine guns and mountings.

2. These equipments have a large number of parts liable to damage or failure through dirt and rust; cleaning and oiling are therefore necessary to preserve them.

3. To ensure correct functioning at all times, it is essential that the guns and mountings are lubricated with the proper lubricants. This applies in particular to the Hispano gun which is very liable to failure, due to dirt and rust on the working surfaces.

4. When cleaning the gun mechanism and working parts of the mountings, oil only will be used. No part will be burnished or polished with any abrasive material.

5. Lubricators and lubricating holes on the mountings will be kept free from dirt and paint in order to allow free passage for the lubricants to the working parts.

6. Tables 1 to 4 detail the lubricants to be used with 20 mm guns and mountings under normal service conditions.

7. Lubricants for use under hot, tropical, and other special climatic conditions are under investigation and instructions will be issued at a later date. Meanwhile the lubricants as detailed in Tables 1 to 4 will be used.

8. Under active service conditions it may sometimes occur that the lubricants specified are not readily available. Table 3 gives a list of alternatives which may be used temporarily under such conditions.

Table 1:—Lubricants for 20 mm guns

Purpose	Hispano Gun	Oerlikon Gun	Polsten Gun
Cleaning of bright parts and working parts	Oil "A"	Oil "A"	Oil "A"
Lubrication of internal and external surfaces	In temperatures below 20° Fahrenheit dilute with kerosene vapourising.		
(a) Cold temperatures	Oil, mineral hydraulic buffer CS 1117B	Oil "A"	Oil "A"
(b) Normal temperatures	Oil "A"	Oil "A"	Oil "A"
Lubrication of springs	——	——	Grease No. 0 CS 1879
Magazine lubrication	Clean with 50/50 mixture of Oil "A" and kerosene, vapourising. Lightly lubricate working parts with Oil mineral, hydraulic buffer, CS 1117B and spring with Grease No. 0.	Grease No. 0 CS 1879 on mouth of magazine and on magazine spring.	Grease No. 0. CS 1879 on the mouth of magazine and on magazine spring (60 and 30 rd magazine)
Ammunition lubrication	*NIL* (fired dry) *Note*:— If American steel cased ammunition is used, slightly oil case with Oil "A". This may also be done if hard extraction is experienced with American ammunition.	Grease rounds by hand with Grease No. 0, CS 1879. (With new magazines lubrication of ammunition should be liberal.)	As for Oerlikon Gun

Note:—Kerosene, vapourising is specified above for the dilution of certain lubricants in cold climates. If this proves to be unobtainable, then the other grade (kerosene, burning) may be used.

Table 2:—Lubricants for 20 mm gun mountings

(Universal, Haszard-Baird, and Airborne mountings)

Purpose	Lubricant to be used
Cleaning of working parts, bearings, etc.	
(a) Cold temperatures.	Oil, low cold test No. 2 CS 1721
(b) Normal temperatures.	Oil as for guns in Table 1 Oil "A"
Lubrication of bearings, etc. fitted with grease nipples, wheel hubs and towing eyes.	Grease No. 0. CS 1879
Lubrications of gear wheels, etc. (Universal mountings only).	
(a) Cold temperatures.	Oil low cold test No. 2. CS 1721
(b) Normal temperatures.	Oil "A"
Recoil units.	Grease No. 0. CS 1879
Gun Slides (for Hispano guns).	Grease Graphited, RD 1179

Table 3:—Permissable alternative lubricants

Specified Lubricant	Permissable Alternative	Remarks
Oil, mineral, hydraulic buffer, CS 1117B	Oil D.T.D. 44D	R.A.F. equivalent
Oil "A"	(a) Oil M 80	In normal temperatures
	(b) Oil, mineral, hydraulic buffer, CS 1117B	In normal to cold temperatures
	(c) Oil D.T.D. 44D	R.A.F. equivalent to (b) above
Grease No. 0. CS 1879	(a) D.T.D. 143C	R.A.F. equivalent
	(b) AN—G—3A	United States Air Corps
Grease graphited, RD 1179	(a) Grease GS graphited	In normal or hot temperatures only. Either should be available wherever there is transport.
	(b) Heavy mineral oil e.g. 30 HD	

Table 4:—Additional information

(To assist when submitting demands, the following information is appended)

Oil	V.A.O.S. Section	Cat No.	Remarks
Oil "A"	H 1	HA 0119	—
Oil M 80	H 1	HA 0145	—
Oil, mineral, hydraulic, buffer CS 1117B	H 1	HA 0148	5 gall drum
		HA 5852	1 Qt pack
Oil, low cold test, No. 2, CS 1721	H 1	HA 5592	5 gall drum
		HA 5583	1 Qt. pack
Grease graphited RD 1179	H 1	HA 6009	28 lb pack
		HA 6017	1 lb tin
		HA 6015	16 oz Refiller tin

NOTES ON THE EVOLUTION OF SMALL ARMS

Among the many interesting things that are contained within the Tower of London, there is one of the finest collections of Small Arms, ancient and modern, in the world. There are specimens of firearms that date back to very early periods and as the times changed, so these lethal weapons changed also.

The first important thing to note is the invention of Gunpowder. The credit for this goes to one Roger Bacon, who in the year 1248 made this somewhat daring discovery. It was not however until the 14th Century that Gunpowder was put to the use of propelling missiles.

The FIRST Small Arm that was used was named the "HAND GUN". This consisted of a rough metal tube which was stopped at one end. Attached to this end was a staff which was held when the weapon was in use. To fire the charge, a slow burning match was applied to the rear end of the tube which had a small hole in it. This hole gave access to the charge. Soon after the advent of the "Hand Gun" came a slight change and this was the fitting of a Butt in place of the staff. Soon after this a Pan was formed on the side of the Weapon into which a small quantity of Gunpowder was placed. This was ignited by a further improvement to the Weapon, a COCK. This Cock was operated by a Trigger, which brought the match down into the Pan. These Weapons were known as "HARQUEBUSES" and at that time easily penetrated the armour at close range.

The 16th Century brought still another change and this time it was brought about by a number of Germans. This was an alteration of igniting the charge and was called the "WHEEL LOCK". This indeed was quite a step in the way of actions, for it had a definite principle. However, being so costly it was applied only to Sporting Guns.

Then GROOVES were made in the bores of Firearms. There seems to be a little controversy as to why these grooves were made. Some say that they were for the purpose of making the bullet fly a greater distance, but it is widely believed that they were to enable the loading of the bullet from the muzzle. These grooves were finally made spirally down the bore, but it was not until after quite a long period that scientific investigations found that the bullet followed these grooves. This, it was found made the bullet have a longer range and above all it made the weapon more accurate.

The FIRST RIFLE OF BRITISH MAKE was the „BAKER RIFLE" and this was issued to the British Army in 1800. It was a large bore Weapon with SEVEN grooves. The NEXT Rifle was made some 30 years after the Baker Rifle and this was the "BRUNSWICK RIFLE". It was fired by a percussion cap and was in this respect different from the Baker Rifle, which was a Flintlock Weapon.

Soon after the advent of the Rifle there were difficulties to be overcome with the ammunition. What was required was a bullet that would conform to the rifling. The first instance of this was the bullet invented by a Frenchman, and it had a hollow base which expanded with the explosion of the charge and so filled the grooves.

It was after this that the first "ENFIELD RIFLE" was made and had THREE grooves, it had only half a turn in the whole 39 inches length of the Barrel. There were still the same defects met with in this Weapon, namely, it was inaccurate and the ammunition was still at fault.

Some years later a man named JOSEPH WHITHWORTH was asked to experiment with Small Arm Barrels and Bullets. He advised the makers of the Enfield Rifle to reduce the bore, make a longer Bullet and give the rifling a sharper twist. It was discovered that the Black Powder was being deposited and forming a great amount of fouling in the Barrel, and this problem was solved by a noted engineer by the name of Metford. This man made a Rifle with five shallow grooves and the bullet which was used was composed of lead which was treated to give it a certain degree of hardness. A Wad was placed between the charge and the bullet effectively clearing the bore.

A few years after the coming of the METFORD RIFLING came the MARTINI-HENRY RIFLE. This was a breech loader and the Barrel had 7 DEEP grooves, these grooves were far too deep to be swept clear but it was found that a great deal of firing was necessary before the accuracy of the Weapon was affected.

A SWISS soldier who had quite a lot to do with the bringing in of "JACKETED AMMUNITION" was COLONEL RUBIN. In the year 1883 he invented a Rifle of very small bore which fired a composite Bullet which was composed of LEAD encased with COPPER. It was soon found that this Rifle was superior to the Martini-Henry because of its accuracy, and although the bore was small it was made just as deadly as the British Rifle owing to the fact that the larger charge of Powder gave it a heavier hitting power.

The British Authorities realised the danger this would be if War should break out, and so a Rifle was decided upon; their ultimate decision was the MAGAZINE "LEE-METFORD" RIFLE. The Barrel was of .303 inch calibre, with SEVEN SHALLOW grooves and the rifling had a twist of one complete turn in 10 inches of the Barrel. The Bullet was composed of lead, jacketed with cupro-nickel. The charge was composed of compressed Black Powder and gave this weapon a Muzzle Velocity of 1800 feet per second.

The rifling of the LEE—METFORD was improved upon and a rifling which had SHARP grooves instead of gradual curves as in the Metford system of rifling was introduced. This proved a great success and is still in use to this day in the present Rifles in use by the British Army.

The FIRST BREECH LOADING WEAPON which was used in the British Army was the SNEIDER RIFLE. This was effected by a block swung on a

hinge and it contained a loaded Striker. To LOAD the Rifle, the block was swung on the hinge, the cartridge inserted and the block replaced. The block was kept in position by a Catch and the rear end of the Striker protruding at an angle from the upper surface of the block. This was struck by a Hammer which caused the Striker to protrude and fire the charge.

The MARTINI-HENRY action followed this and it was proved to be a vast improvement on the Sneider action for it was compact and strong. It was operated by a lever which lowered the Breech Block and ejected the spent cartridge, it also revealed the Chamber.

Ing England a Small Orms Committee had been formed in 1883 to consider the question of improving the Martini-Henry Rifle. Much useful work had been done and an improved Rifle would have resulted of the single shoot, breech block type, but the trend of design had by 1886 altered and made it necessary for the Government to immediately consider the adoption of a Magazine Rifle. After testing numerous designs a Rifle of .303 inch calibre using LEE's action and magazine and METFORD's rifling was tried and proved satisfactory. It was adopted in 1888. Although it has from time to time undergone modifications, the Lee action and magazine are with us today in our Rifles Nos. 1, 4 and 5.

As the result of experience gained in the South African War a Rifle was designed which would be suitable for all arms of the Service, i.e. short enough for a Cavalry man to carry it in a bucket and yet long enough for the Infantryman when using it with a fixed Bayonet. It was fitted up as a multiple loader, which made it necessary for the soldier to be supplied with his ammunition in chargers, each containing 5 rounds. This Rifle, known as the "RIFLE SHORT MAGAZINE, SEE-ENFIELD MK 1" was issued in 1903. It has been modified on several occasions but is substantially the same as the Rifles No. 1, 4 and 5.

Just prior to the 1914—1918 War, the British Government's Small Arm experts had been carrying out extensive trials with a Rifle which combined all the best points in the modern design of military Small Arms. The action was a modified MAUSER type with a much stronger Barrel than that of the Short Rifle. The Sighting was of the Aperture type. It was the intention to get a Muzzle Velocity of at least 2,800 feet per second from this Weapon, the bore of which was .276 inches.

Experiments proved that in order to get this high Muzzle Velocity the heavy charge necessary unduly heated the Chamber and made the Rifle under certain circumstances dangerous to use.

The 1914—1918 War broke out at this stage of the experiments. The designs of the Weapon were turned over to American Small Arms firms who made a number of them for the British Government, but fitted them up with .303 inch Barrels (Enfield). These Rifles were fitted with Telescopes and were extensively used during the 1914—1918 War as Snipers' Rifles.

GENERAL STRUCTURE

In the manufacture of weapons many things must be considered even before we come to such things as, action, feed, firing etc.

Principle amongst these are:—

WEIGHT MOBILITY STOUTNESS

These items may be dealt with together.

The Weight must be such that in most cases of S.A. and M.G. equipment the weapon can be easily handled, yet sufficient in strength and thickness to withstand not only the mechanical stresses and strain but also the rough usage that it is likely to pass through, particulary in wartime. In the case of hand weapons, rifles, pistols, carbines etc., the lightness is very essential. Machine Guns are divided into three types, LIGHT, MEDIUM and HEAVY. The light machine gun is that which can normally be carried by one man, shoulder fired and normally fitted with a bipod or light tripod. Bren, Vickers G.O. and Browning are the most commonly used. The most common ground medium M.G. is the Vickers Mk. I., a comparatively heavy weapon fired from a heavy mounting. In A.F.Vs. are mounted Besa and Vickers M.G., both medium. Here of course the weight need not be considered from a mobility point of view, the difference of a few pounds make little difference to a vehicle weighing anything from 7—30 tons.

Heavy M.Gs. such as Polsten Oerliken, .50 Browning are invariably on a mobile mounting, unless of course the weapon is static. These are normally used in A.A. role but also used against soft transport or light armoured vehicles. A limited number of these heavy M.Gs. have been mounted in and on A.F.Vs.

PRINCIPLES OF S.As. AND M.Gs.

Before dealing with individual weapons it is advisable to study the principles which are demanded in the construction of weapons, features which are universal and must be considered in production.

Barrel

Usually a tapered steel tube, the external diameter at the muzzle or front end being smaller than that at the breech or rear end. The breech end is reinforced, as the word signifies it is a strengthening to withstand the pressure of the propellent gases, this portion is known as the "*reinforce*". Where a heavy barrel is used the "reinforce" is not noticeable. Some barrels have a swell at the muzzle known as "*muzzle swell,*" very seldom found in British barrels of small calibre.

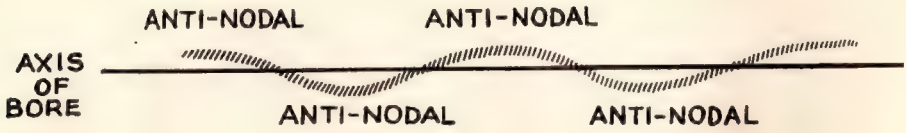
The interior of bore of the barrel is what is termed "rifled" and here we come to a very interesting subject. Rifling is the cutting of spiral grooves throughout the length of the bore, to impart a spin to the projectile as it travels along the bore thus imparting a stability to it when it has left the bore. Kotter of Nuremburg was the first person credited with realizing the importance of rifling, that was in 1520, but it was not until the middle of the 19th century, when experts began to stress its importance and Whitworth was granted funds for the purpose of designing suitable rifling for the British Government. The story of rifling is something too big to be incorporated in this lecture.

Number of grooves, depth, number of turns, etc., vary, but one can give figures that cover the weapons of calibre under one inch. No. of grooves is from 4 to 6 and can be either left or right hand twist, the former is known as "*Enfield Rifling*" and the latter as "*Continental Rifling.*" The average number of *twists* is usually one complete turn in 30 calibres of the barrel, in the case of a .303" barrel, that is one turn in ten inches. It has been decided by trial and error that this is the best. Effort to increase the number of turns proved to be disastrous and in one known case when the twist was increased to one in 18 calibres, the velocity of the bullet was so great as it passed through the bore, that it failed to spin at all and resulted in loss of stability.

Depth depends on the bullet. .005" to .008".

Weight of the barrel must be considered. The bullet or projectile in its travel through the bore sets up vibrations and the heavier the barrel the less vibrations there are, but too heavy a barrel would make the weapon needlessly unwieldly.

In M.Gs., the barrel may be a trifle heavier than in a rifle, so vibrations are reduced. The most familiar way of controlling vibrations on a rifle barrel is to anchor the barrel to a stock at one or two anti-nodal points. The sketch will best define this:—



AB is the true axis of the bore. CD is the undulating line representing the vibrations set up by the bullet in a spiral form. It will be seen that, if the barrel is anchored to a stock at one or more of the anti-nodes, vibrations can be reduced and controlled. One other thing caused by vibrations is "Jump". The bullet leaves the bore at a point above or below the true axis of the barrel. There are two types, negative or downward jump, and positive or upward jump. In the case of small arms, jump is taken into consideration when weapons are designed.

The "chamber" portion of the barrel is the enlarging of the bore at one end to accept the case housing the necessary propellant charge.

The "bore" is the interior of the barrel from the front end of chamber to the muzzle.

The "calibre" is the diameter of the bore measured across the lands.

The "lands" are the portions of the bore left between the groove of the rifling.

"Set up" is the expanding of the bullet into the grooves after explosion.

"Drift" is a deviation of the bullet from the line of departure in a lateral direction. It is caused by the turn of the bullet in the rifling—thus if the twist of the rifling is left handed "Drift" will be to the left.

Barrel Faults

Bends

A barrel can be bent in any direction and is detected by shading. The following method is usually employed:—

Select a window or other suitable light with a straight and well defined upper edge. Look into the barrel to be viewed and direct the further end

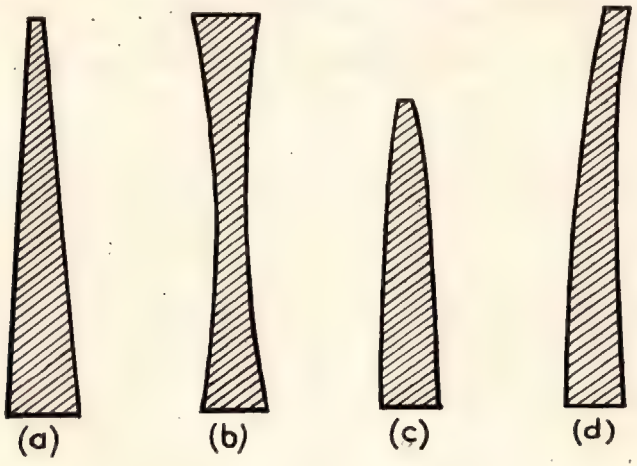
towards the window. Elevate the barrel slowly until the upper edge of the window casts a shadow down the bore. (Use both eyes).

(a) A straight barrel portrays a perfect cone.

(b) If cone has concaved sides, barrel is bent upwards.

(c) If cone has convex sides, barrel is bent downwards.

(d) If cone is telted left or right barrel is bent in direction of tilt.



When viewing rifle barrels for straightness of bore, it must be remembered that the fore end can influence the barrel, so should a barrel appear bent the fore end should be removed and the barrel re-viewed.

A "Lapped" barrel gives the appearance of a downward bend in all positions.

"Puckers" are caused when breeching up is in progress and show a dark oval mark. Collect nickelling very easily (Rifle Barrels).

"Bulges" are caused by obstructions in the bore. The bullet causes the air in the barrel to be compressed at a point directly behind the obstruction, the air compression being so great the walls of the barrel bulge under the strain. Bulges appear as dark rings. Where the obstruction is not blown out by compression of air the barrel may burst.

"Cuts" show as lines along or across the land. Usually caused by incorrect use of cleaning rods.

"Erosion" is the washing away of the metal or the bullet lead by the heat generated by propellent gases.

"*Corrosion*" is caused by a chemical, formed by the percussion cap gases being deposited on and forced into the walls of the hot barrel. In their own time the gases exude from the metal in what is known as "sweating" and form a deposit of moisture in the bore which subsequently turns to rust. The use of boiling water prevents subsequent "sweating" to a great extent. The rust if left eats into the metal and causes "pitting."

Metallic Fouling and Nickelling

When visible this appears as a streak or lump of metal adhering to the lands, usually towards the muzzle. These streaks are deposits of nickel torn from the bullet jacket during its passage through the bore.

Superficial Fouling

Deposit left in the bore by the explosive charge, i.e. bits of ash, cordite, etc. Should be removed otherwise rust will form.

Cordwear

Cause by the improper use of pull-throughs, usually at muzzle but does occur at breech. Metal of the bore is worn away and a small channel appears. Badly cordworn barrels at muzzle can cause drifting and gnawing of bullet, resulting in key holing consequently causing inaccuracy. Where breech is badly cordworn the case will expand into the wear giving hard extraction.

Rust

This is caused by the bore being left dry and exposed to damp atmosphere.

Chambers

Enlarged or bulged chambers may be found due to excessive pressure, or the use of abrasives when cleaning. To determine defect in chamber a mould may be made from sulphur and graphite.

ACTIONS

The design of every weapon, automatic, self loading and hand operated must incorporate means of carrying out the following essentials:—

LOADING FEEDING LOCKING (In certain types of weapon).
FIRING EXTRACTION EJECTION SAFETY (Applied).

1. **Loading** can be carried out by making provision for a feed block to accommodate a bolt, through which the bolt is automatically passed and the rounds withdrawn (Vickers) or driven forward (Besa). In this type of weapon the loading operation is carried out by inserting the belt into the feed block, it being retained and prevented from dragging by pawls. A strip may also be used in the same manner

or

By a feed or magazine opening fitted with catches to retain magazine in position and permitting quick change. The rounds being driven straight into the chamber by action of recoiling portions. In automatic weapons, automatic feed is obtained through the medium of the backward and forward movement of the recoiling portions.

2. **Feed**

See separate précis on "Feed."

3. **Locking and Mechanical Safety**

Until recent years it was considered essential that the breech must be locked before the firing pin could strike the cap during firing, and after firing until such time as the bullet had left the muzzle. This was termed "Mechanical Safety." With bolt action weapons it is usual for threads or lugs on the bolt to be rotated into grooves or recesses in the body (Rifles No. 1 to 5 Hotchkiss & Lewis M.G.). Breech Block Locking by Lifting and Engaging behind a Shoulder in the Body (Bren). Lock positioning below horizontal, Toggle joint (Vickers). Engagement of lock in breech bolt (Browning .303). "H" locking piece (Thompson M 1928A1).

All these types of Mechanical Safety are positive locking action, but the modern trent is to simplify the action of weapon consequently the "blowback" action was produced. Here the mechanical safety, if one can term it such, is brought about by the use of a heavy bolt or breech block, relying on weight to overcome the initial backward thrust of the propellent gases. The Polsten, Sten, Thompson A1 and M1A1, and S.M.G. M3 are weapons in which is in corporated "blowback" action.

4. Firing

The firing of a weapon demands a striker or a firing pin, a means of propelling it forward with enough force to strike the cap sufficiently hard to detonate, withdraw it and retain it to the rear. In most cases these three operations are effected by one spring. It is important that one of the first operations after the explosion is the withdrawal of the firing pin or striker from the cap before the block or bolt unlocks. In the case of the "blowback" type of action the withdrawal is not considered to be very important but in the case where the face of the breech block or lock moves up or down to unlock (6 pdr., Vickers .303") in contrast to horizontal movement (Bren, Besa) it is most important.

A trigger or thumbpiece is necessary and some means of connection between it and the firing pin. Rifle No. 4 action is a very simple example of this. Methods of relationship between firing pin and trigger are much too numerous to enumerate here and will be dealt with when studying individual weapons.

5. Extraction

This is the term applied to the withdrawal of the empty case from the chamber. As the fired case expands into the wall of the chamber (sealing of breech) it is held very securely. To facilitate withdrawal cases are slightly coned shaped and in the case of the hand operated weapons there is a "primary extraction" or loosening of the case prior to withdrawal. The extractor is usually in some form of a spring loaded claw constituting part of the breech block or bolt. In the .50 Browning the top front face of lock and front of recess in breech block are bevelled to facilitate extraction.

6. Ejection

This is the ejecting or throwing out of the case from the weapons. This is normally obtained by the base of the case on its backward travel striking a projection in the body, being tipped and ejected out of the weapon through an opening in the top, side or bottom of the body. Rifle bodies are so shaped to eject the case before the base reaches the ejector screw.

Safety (Applied)

This is a manually controlled means of ensuring that the weapon will not fire unless the safety is positioned inoperative. It takes the form of variously shaped and positioned components usually designed to render the sear inoperative or hold the firing pin to the rear. As can be understood the minimum amount of effort and movement should be necessary to operate the safety, consequently it is always extremely accessible. On some weapons the safety can be applied both in the "Cocked" and "Fired" positions (Rifle, Bren), in others, only when "Cocked" (Pistol Auto). Certain weapons have no applied safety (Pistol Rev.).

BREECH SEALING — BREECH LOCKING

The breech is sealed by the expansion of the case into the chamber on explosion of charge, incorporated with a locking device or heavy bolt or breech block to ensure that recoiling portions are not driven to the rear before the bullet has left the barrel.

Prevention of premature unsealing of the breech is brought about by one of three methods:—

1. Breech positively locked at instant of firing.
2. Use of heavy breech block or bolt, sufficient in weight to momentarily check the backward thrust of gases.
3. No positive lock but locking piece to check backward thrust.

1. Several methods of positive lock are used:—

   (a) Sliding Block — 6 pdr. Block working in grooves of breech ring.

   (b) Breech Block — Bren, Besa, Vickers G.O. Block lifted and locked between rear of barrel and locking shoulder.

   (c) Bolt — Rifle Lewis.
   Browning .30"—Browning .50".
   Lugs engaging in recess.
   Lock engaging in recess.

   (d) Lock — Vickers .303".
   Forming of Toggle joint.

2. Use of heavy breech block or bolt but no positive lock. Direct blowback.

   (a) Heavy Bolt — Sten, Thompson S.M.G. M1.
   Thompson S.M.G. M1A1, S.M.G. M3.
   Round struck when fully home.

   (b) Heavy Breech Block — Polsten Oerlikon.
   Round struck before fully home.

3. No positive lock but locking piece to check backward thrust.

   "H" Locking Piece & Heavy Bolt — Thompson S.M.G. M1928A1.
   Backward movement of bolt unlocks "H" locking piece.

OPERATION (AUTOMATIC WEAPONS)

Where a weapon is not hand-operated some means of re-cocking and re-feeding must be devised. When this is incorporated in a weapon it is termed automatic.

There are four main types of operation—

(a) Gas operated.

(b) Recoil assisted by gas.

(c) Recoil.

(d) Blowback.

1. In gas operated weapons the gases usually pass through a vent in the barrel into a gas regulator and from there impinge on a piston which moves to the rear unlocking the breech. One advantage of this type is that gas can be regulated by means of the gas regulator. Bren, Vickers, G. O. and Hispano are weapon embodying this type of operation.

2. The Vickers Mk. 1 is recoil operated, assisted by gas. Here, force of explosion drives the recoiling portions to the rear; assisted by gases which, on leaving the muzzle, strike against a cone and re-bound on to a cup screwed to muzzle of barrel, assisting in backward movement. Browning .30 same principle.

3. Recoil only is used in the Browning MG .50. Force of explosion drives the recoiling portions to the rear until such time as the lock is allowed to drop thus unlocking action. Gases are still sufficient to drive the bolt to rear.

4. Blowback action is something which has been incorporated in automatic weapons quite recently. The breech is not locked, a heavy bolt or breech block is used so that gases are just sufficient to check forward movement and then drive bolt or breech block to the rear. Here the gas cannot be adjusted, therefore examination of springs which control the backward movement of recoiling portions must be thorough.

Besides "Automatic" weapons we have "Semi-Automatic" weapons. In this case, re-cocking and feed are done automatically but the trigger must be released and operated to fire every round.

FEED

Small Arms are fed either by strips, belts or magazines which presents the round in such a way that the bolt, breech block or lock can transport it into the chamber ready for firing.

L.M.Gs., Rifles, Carbines and Pistols are invariably magazine fed as this is the most convenient method conducive to portability. M.M.Gs. and H.M.Gs. which must be capable of sustained high rates of fire are usually belt fed. The belts may be either fabric, disintegrating metallic, metalling or metal-cum-fabric holding 225-250 rounds. The Hotchkiss M.M.G. is fed by strips holding 30 rounds.

One H.M.G. which is magazine fed is the Polsten which is essentially an A.A. weapon. The magazines contain either 30 or 60 rounds and are quick change type.

For use with multiple MG mountings for AA and AFV use, guns are fitted with either left or right hand feed which may take the form of different feed blocks (Vickers) interchangeable feed components (Browning .30" and .50") or left and right hand magazines (Polsten).

COOLING

Cooling of gun barrels, especially automatic guns firing at a prolonged high rate of fire is essential to limit the rate of wear by erosion of the bore.

This is accomplished by one of the following methods:—

(a)	Quick Change Air Cooled Barrels	— Bren
(b)	Water Cooling	— Vickers .303"
(c)	Radiator Assisted by Air	— Lewis
(d)	Heavy Barrel	— Polsten, Browning .50" Besa.
(e)	Heavy Barrel with Radiating Rings	— Hotchkiss
(f)	Heavy Barrel assisted with perforated jacket	— Browning .30"

(a) With the quick change air cooled type of barrel, it should be removed from the gun and replaced by its "S" barrel after firing the number of rounds laid down as maximum. In an emergency it may be plunged in cold water to cool but should normally be left to cool normally. Advocated to plunge Polsten barrels into water.

(b) Water cooling is carried out by the barrel being enclosed in a barrel casing made water tight by means of asbestos packing. On firing the heat is absorbed by the water, which with sustained high rates of fire evaporates, the steam passing through a steam tube to a condenser enabling it to be used again, also preventing the disclosure of location by escape of steam. Water bags are carried by the gun crew to replenish.

(c) Cooling by means of a radiator is achieved by fitting to the barrel a casing of light heat conducting material, usually aluminium, which is formed with a number of longitudinal fins the heating travelling from the walls of the barrel through the radiator fins and in the case of the Lewis being dispersed by a current of air drawn over the radiator by the vacuum formed by the gases converging on the walls of the front radiator casing after the bullet has left the barrel.

(d) The heavy barrel as fitted to Browning .50" takes far longer to heat up and is only fitted to guns from which sustained high rates of fire are not required, for example A.A. where the period of engagement of target is merely seconds.

(e) Radiating rings are integral with the barrel so that heat can be conducted to their edges and quickly exuded to the air.

(f) Here the heavy barrel is encased in a perforated jacket permitting flow of air between jacket and barrel.

TYPES OF SIGHTS

Foresight	Bead. Usually Sports Guns, P.I.A.T. Blade. Rifle, Vickers Mk I, Pistol, Bren. Inverted "V" or Barleykorn. Hotchkiss, and Pistols Auto.
Backsight	Aperture mounted on leaf. Rifle No. 4, 5, Bren Mk 2, 3, 4, Vickers Mk. I. "V" or "U". Pistols, Rifle No. I.
Telescopic	Crosswires or Pointers adjustable for Range. A.F.V. Mountinls and Snipers Rifles.
Windgauges	Rifle No. 1. U.S.A. Weapons.

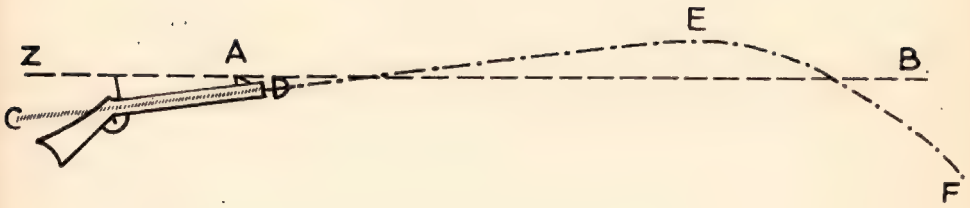
Indirect Sighting normally used on Mortars or P.I.A.T. when used in Mortar role. Here correct sighting is made by the levelling of bubbles on instruments.

Sights are the means of laying accurately a direct aim on a target, though not in line with the axis of the bore either laterally or vertically, or both; and may be one or a combination of either of those enumerated above.

To permit adjustment or zeroing, the foresight is always manufactured in various sizes + and — of a zero in variations giving a known vertical alteration of the strike on a target at various ranges. They are also fitted in a manner permitting lateral movement to correct an error for line, where no provision for lateral movement of the backsight is made.

Backsights are fitted to either a radial or tangent leaf and are adjustable to permit engagement of target at varying ranges usually at distances of 200—2000 yds in 50 yds variations. P.I.A.T. and Pistols excepted. Adjustment is affected by movement of the sight up or down a hand operated screw thread on a vertical leaf or by sliding up or down a leaf mounted on a ramp.

Compensation of error between axis of bore and axis of sight is accomplished by gravity and drift at the longer ranges. At short ranges, up to 100x the error is known, and admissable e.g. zeroing. Jump and vibrations in the barrel are allowed for in design.



ZAB ___ Line of Sight
CD ////////// Axis of Barrel
DEF —·—· Trajectory
E = Culminating Point

Use of sights

Tip of blade in centre of "U" or "V" and in line with top edge.

The blade in centre of aperture.

"U," "V" or aperture and blade should always be dead black to prevent any reflection of light.

Sight radius

Sight radius is the term applied to the distance between the tip of the foresight and the "U," "V" or aperture of the backsight.

Zeroing formula

The formula used to determine the size of foresight required to correct an error in accuracy is as follows:—

$$\frac{\text{RANGE} \times \text{DIFFERENCE IN HEIGHT OF FORESIGHT}}{\text{SIGHT RADIUS.}} = \text{VARIATION ON TARGET}$$

BUFFERING

Buffering can be incorporated in a weapon to take the initial shock of discharge thus decreasing the blow on the shoulder. In automatic weapons where the recoiling portions move at anything from 500 to 1200 times a minute there are certain points where metal meets metal with force. Here buffering is incorporated to absorb any shock. When recoiling portions are driven to the rear compressing the return spring it is possible that this spring is unable to absorb all the backward thrust, so, housed in either the rear of the bolt or at the rear of the body is some combination of springs to absorb this surplus energy. Again when the sear lies in the path of the recoiling portions which are being driven forward by a compressed spring it may be considered necessary to absorb the blow, as in the Polsten and Vickers G.O. Guns.

MUZZLE BRAKES

These are not considered necessary on Machine Guns. However the 6 pdr. O.Q.F. has a muzzle brake fitted to exert a retarding effort on recoil. As the projectile leaves the muzzle some of the gases are allowed to escape through four side vents of the muzzle brake thus reducing the amount of gases which follow the projectile through the muzzle brake. The escaping gases impinge against the forward end of the brake giving a momentary check. A Recoil Reducer is fitted to the muzzle of certain 20 mm Hispano Guns.

RUSTPROOFING OF SMALL ARMS AND MACHINE GUNS

After manufacture and subsequently as found necessary, all Small Arms and Machine Guns are treated by one or more of a variety of processes to withstand rust.

The methods at present in use are Browning, Sandblasting, Painting and Parkerising, and here follows a survey of each method.

BROWNING

This is the process to be followed by Armourers in Regimental Armourers Shops and REME Workshops where without Sandblast.

The following quantity is sufficient for 50 Rifles, one third of this quantity will be sufficient for 50 Bayonets and Scabbards:—

Rain or Soft Water	12 ozs
Blue Stone (Copper Sulphate)	1/16
Nitric Acid	1 1/4 ozs
Tincture of Steel	3 1/2 ozs
Spirits of Wine	2 ozs
Spirits of Nitre	3 ozs

The above ingredients will be mixed by the Armourer in the order shown, directly they are received. Officers Commanding Units will caution Armourers against keeping the ingredients packed in separate bottles, as danger from fire is likely to arise from the Nitric Acid if it is spilt before being mixed with the other ingredients.

If the Armourer has a larger quantity of ingredients than he actually requires for the arms he has to brown, he will at once return the surplus to the Quartermasters Store.

Ingredients for Browning mixture should be measured by Fluid Measure as follows:—

60 minims = 1 dram
8 drams = 1 oz
20 ozs = 1 pint.

THE BROWNING PROCESS

1st Day

Boil the components in strong soda water for 1/2 an hour, (1 1/2 lbs of Soda to 1 gallon of Water) to remove the grease. Wipe down with clean wet cloths to remove the soda (inside of Barrels to be wiped out with rod and wet jute).

When Barrels and components are cold, coat with the mixture rubbing the first coat well in. Stand in a dry place for 3 to 4 hours, then coat cold with the mixture again and stand in the Drying Room for the night.

2nd Day

Boil the components in clean water for 20 minutes and when cold, scratch off. Coat cold with the mixture and stand them in a dry place for 3 to 4 hours. Then coat cold again and stand them in the Drying Room for the night.

3rd Day

Repeat as for the 2nd Day.

4th Day

Boil in clean water for 20 minutes. When cold, scratch off and oil.

NOTE:—For the First Coat take 2 ozs of the Mixture and add 1/4 oz of Nitric Acid. *This applies to the First Coat only.*

SANDBLASTING

The following notes on Sandblasting are applicable to the type of Sandblasting Apparatus usually supplied to Central Armourers Shops. These are steam operated. Different makers apparatus may vary in small details but the working principles, in general, will be as described.

Sandblasting is the process by means of which a grey matt surface is obtained on the blades of bayonets to break up the bright surface and prevent reflection of light. During recent years the blades of bayonets have been browned and are now to be polished. Barrels and Handguards of Hotchkiss .303" Machine Guns are sandblasted before painting with oil and gas proof paint. This is done to give the surface of these components a slightly rough finish and enables the paint to grip and not be easily removed by friction when in use. The side plates, locks and connecting rods of Vickers .303" Machine Guns are now sandblasted in preference to being browned. The light grey colour makes it possible to distinguish these components from browned parts of the Gun at night.

Owing to the abrasive or cutting effect of the sand on the article being treated it is most important, especially on machine gun work to protect surfaces, which if they become unduly worn render the article unserviceable.

This is usually done by placing wooden pegs in axis holes or threated holes and covering or protecting surfaces not required to be Sandblasted with tin shields. Another precaution to be taken is that every particle of sand must be removed from the surface of the article after sandblasting, for the sand used, being of a hard and gritty nature, if allowed to remain in the bore of a barrel or the interior of a Vickers Lock would be likely to render these valuable components unserviceable. The surest method of removing the sand is to suspend the components in boiling water, taking care to see that they are thoroughly dried before oiling or painting.

Sandblast apparatus allows of a stream of sand to be directed upwards by steam or pneumatic pressure against the article to be treated. The sand bites into the surface to a minute degree. The pressures of steam or air differ according to the nature of the work required. In commercial life the pressure used for "frosting" glass is from 15 to 25 lbs per square inch. For sandblasting Armourers work, 50 to 60 lbs pressure is required.

The notes from now onwards apply specifically to steam operated apparatus and to type TG2 made by Mathewson & Co. Ltd. Broadheath, Manchester, in particular.

Dry steam is essential to the correct working of the apparatus. For this reason it is necessary to place the apparatus as near as is convenient to the steam boiler. The connecting steam pipe should be covered with a good thickness of felt or other non-conducting material to prevent undue condensation. Should it be necessary to take the steam from a large horizontal steam pipe already in use, the connection should be made from the upper portion of the pipe.

For convenience of fixing and working, the apparatus should be placed a foot or two from an outer wall of the building and the exhaust pipe (not less than 5 inches diameter in any part) carried through the wall and up outside for a distance of at least 8 feet. A small hole (say ⅜" diameter) should be made in the lowest point of the exhaust pipe elbow to allow for the escape of water.

Refer to the drawing supplied for the names of the principal parts of the apparatus.

METHOD OF OPERATING THE APPARATUS

Place the cover supplied over the operating in the Exhaust Chamber at "L." Fill the space between the outer and inner cylinders with clean dry sand (No. 6 Silver sand gives good results). Do not fill with sand above the edge of the conical top of the Exhaust Chamber. Close up the Blast Valve at "O". Turn on the steam at the boiler and open wide the Regulating Valve on the steam inlet pipe (not shown on the drawing). Open the drain cock and allow all water to be blown out. Close the drain cock. Regulate the steam pressure by the Regulating Valve. Steam will now pass through the steam drier to the

exhaust steam jet. This jet, situated inside the exhaust pipe, causes a powerful suction action in the exhaust chamber. Turn on the blast valve "O." Steam will now be forced upwards through the Blast Jet "Q," chilled tube "M" and conical blast tube "J" and be sucked downwards into the exhaust chamber and is essential before commencing to work the apparatus. Now remove the cover at "L." Should steam come out of this opening, either at first or at any time thereafter one or more of the following things will have happened:—

1. The exhaust steam jet is obstructed.
2. The cast iron elbow "F" is chocked with sand.
3. The exhaust chamber is full of sand.
4. An obstruction in the exhaust pipe is causing back pressure.
5. The joint around the upper end of the chilled tube "M" is not airtight.
6. The chilled tube is worn out.

These things being in order, the apparatus is ready for use.

IMPORTANT

Always see that the steam is turned on by means of the Blast Valve "O" before allowing the sand to run, and always stop the sand running before turning off the steam. Otherwise sand will get into the blast jet and ruin it for future use.

The flow of sand is regulated by means of the sand lever "D" to which a circular plate with sand ports is attached. The ports in the circular plate register with holes in the sand box when the lever is to the left. Stops regulate the movement of the lever. If the lever is moved beyond the right stop the circular plate can be disconnected from the apparatus.

If dirt or a lump of sand prevents the steady flow of sand into the Sand-feeder "E," press the Sandlever down until it passes under the left stop and push it as far as it will go to the left.

All sand should be put through a fine wire sieve before being taken into use.

Sand which has become pulverised by use should not be used again.

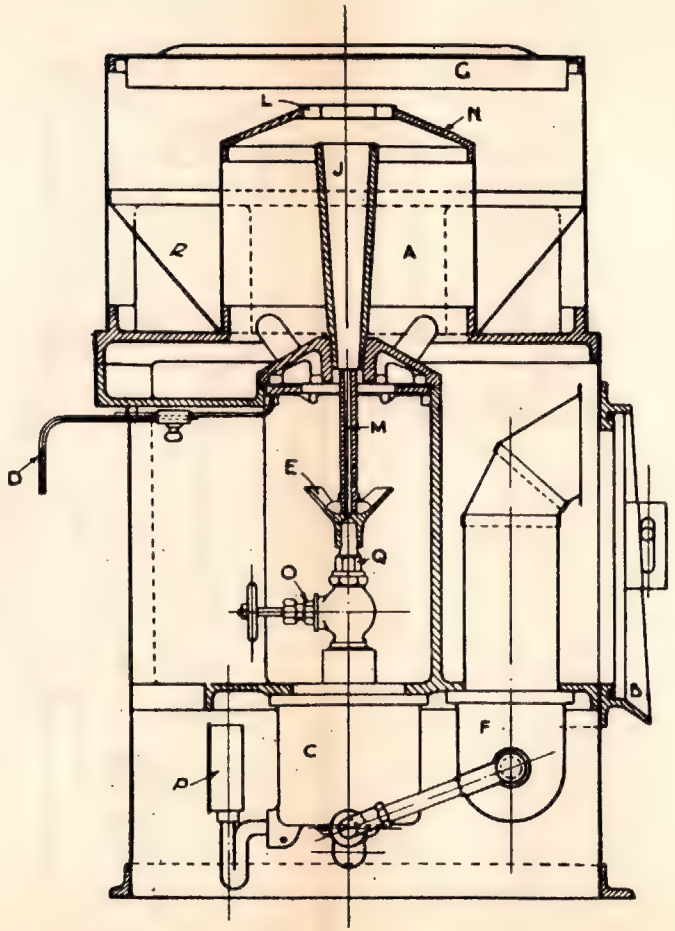
Chilled tubes last on an average four hours when working at 60 lbs pressure. Damp, hot sand is a sign, other things being in order, that the chilled tube "M" requires exchanging.

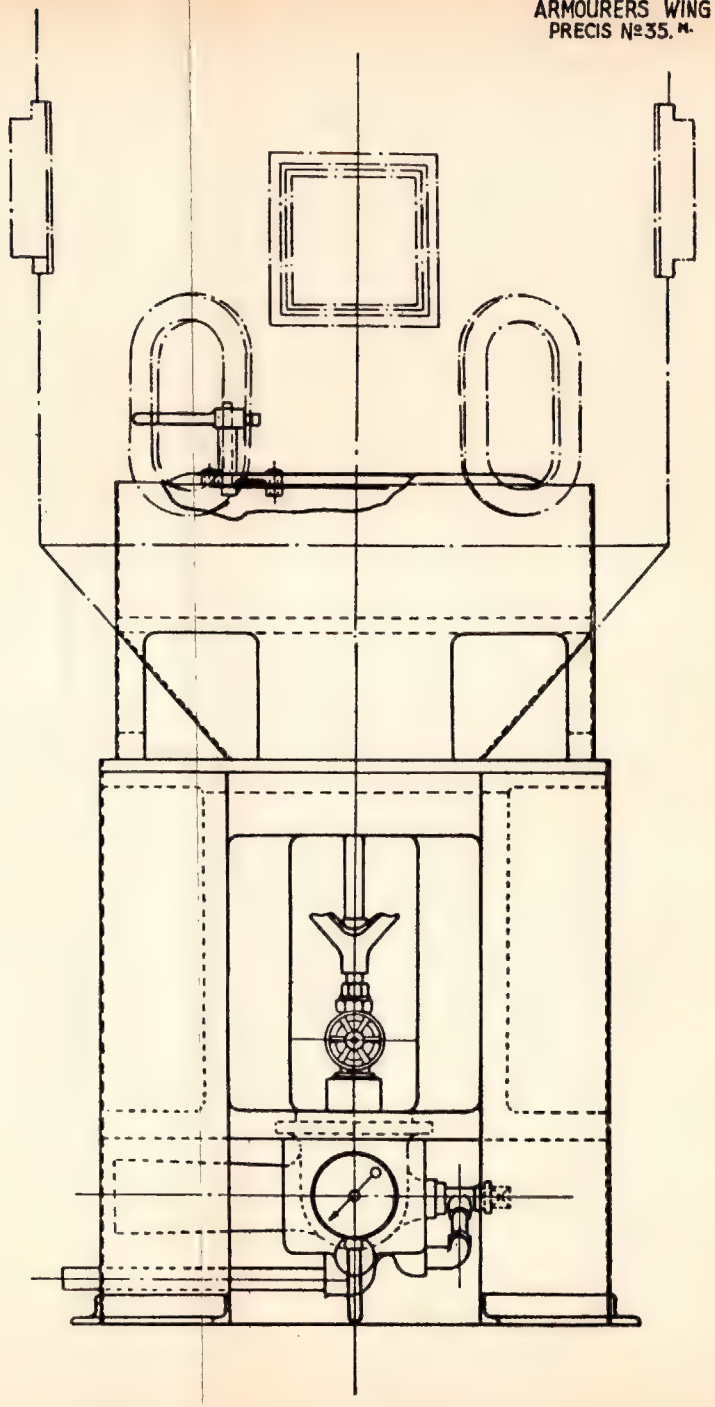
Chilled tubes sometimes require trimming up to make them fit into their seating in the Sandfeeder "E".

PAINTING

Protective Painting of Small Arms, Machine Guns and their Ancillary stores is dealt with in full in EMER SA and MG A211 Pages 1—6 inclusive.

	Description.
A.	Exhaust Chamber
B.	Man hols
C.	Strom drier
D.	Sand lever
E.	Sand feeder
F.	Conical exhaust pipe
G.	Sheet iron cover to the apparatus
H.	
J.	Conical blast tube
K.	
L.	Ring for cover of exhaust chamber
M.	Chilled tube
N.	Cover of exhaust chamber
O.	Blast valve
P.	Pressure Gauge
Q.	Blast jet
R.	Sand box
S.	
T.	
U.	
V.	





SILENCERS

GENERAL INFORMATION

Silencers have been fitted commercially to Sporting Guns for a number of years, but the first silenced weapon in the Service was the Carbine M/C Sten 9 mm. Mk. 2S which was introduced towards the end of the 1939/1945 War primarily for use in Jungle Warfare.

It would be more correct to call a Silencer a Sound Moderator, since the report of the weapon is not 100 % eliminated.

Silencers of various types can be fitted to most types of Small Arms and Sporting Guns from calibre .22" to Medium Machine Guns.

THE PRINCIPLE

The noise heard when a gun fires, consists, generally, of two reports: one made by the actual bullet, the other by the escaping gases, generated when the charge is exploded. The report is caused mainly by the gases, which naturally are expelled with a similar velocity to the bullet, but the volume being greater the impact with the air is heavier. It is this sudden impact with the air by a large mass which causes the loud sound which is heard. A bullet makes a noise when passing through the air and the velocity of the bullet exceeds the speed of sound (1100 feet per second). To hear that noise it must be reflected back by some object, usually the ground or buildings. There are, therefore, two "noises" to be controlled when a bullet has a muzzle velocity of more than 1100 feet per second, and as most modern ammunition develops a higher muzzle velocity than this, the noise of the bullet will be heard in direct proportion to its velocity. Up to the present, this bullet "noise" cannot be eliminated.

Control of Gas "Noise"

It is a simple matter to control the speed of the gases entering the air by passing them through some form of container fitted with a series of baffle plates which break up and slow down the escaping gases. The first difficulty which crops up in gun practice is that the mass of gases is relatively speaking large and a container to hold the whole volume of gases would be out of all relation with the size of the weapon.

To obtain 100 % silence it is necessary to control all the gases; if the silencer is too small, part of the gases will fill it up and the balance will follow the bullet through the centre and still make a loud report.

Therefore the silencer has to compromise between efficiency and practicability, and usually accommodates from 80 % to 90 % of the gases and therefore silences the gas report by a similar amount.

Effect on Recoil

Though of secondary importance, it is found that a forward pull is given to the weapon by attempting to retard the gases by a series of baffle plates. To a certain extent this compensates the backward "kick" of the weapon.

Effect on Accuracy

New vibrations are set up by the silencer but unless the barrel is abnormally light this is not noticeable. The extra weight at the end of the barrel may effect the shooting slightly by altering the point of impact an inch or two for every 100 yards range.

TESTS FOR EFFECTIVENESS OF SILENCERS

While the Silencer reduces the report made by the escaping gases it cannot eliminate the noise made by the bullet passing through the air. This is easily proved by two simple tests:—

Test No. 1

Take the weapon fitted with a silencer and fire into a bag of soft earth or sand, holding the muzzle within three or four inches of the bag. All that should be heard is a heavy "grunt" made by the impact of the bullet against the sand. The distance is so short that there is small opportunity for bullet flight noise to develop. After trying this, step back 25 feet and again fire into the bag. A sharp "crack" will be heard—this is the bullet flight noise. The report must be the same in both cases and has been almost entirely eliminated.

Test No. 2

Select an open field clear of any objects and buildings. Fire the weapon without the silencer straight up in the air and then parallel with the ground. The report noise will be heard both times. Now fit the silencer and repeat this procedure; when fired up in the air only a "soft" noise should be heard. The report has been eliminated and the bullet noise is not heard because there is nothing to reflect it back. Now fire parallel with the ground; a sharp "crack" will be heard this is bullet flight noise.

Bullet Flight Noise will only be heard when using ammunition which develops a muzzle velocity exceeding 1100 feet per second.

Even though bullet flight noise can be heard it is impossible to tell from which direction the weapon has been fired. Only the gun report will indicate this.

GENERAL HINTS FOR SILENCERS

Keep thie Silencer scrupulously clean. If the weapon is fired when there is an oil deposit in the silencer a cloud of blue smoke will be emitted which will not only give away the firer's position but will obscure the sights.

Automatic weapons should be most carefully cleaned after use as the silencer causes more fouling to blow out at the breech end than is normally the case.

SPECIMEN TYPES OF MILITARY SILENCERS

Carbine M/C Sten 9 mm. Mk. 2S

This Silencer consists of a drawn steel tube 12¼" long and with an external diameter of 1½" which is screw threaded at its rear end, internally, to screw on to the Nut Barrel of the Carbine. The Silencer is further secured to the Nut Barrel by a screw. Two inches from the rear end is fitted a Plug Barrel Bearing which is secured by two snap headed rivets. This forms the seating for the muzzle end of the Barrel. Forward of the Barrel Bearing Plug are fitted 18 baffles. These are "cup shaped" plates bored centrally to allow the passage of the bullet. At the forward end, a screwed plug is fitted which screws down onto a tubular cup which acts as the 19th baffle and also as the means of ensuring that the baffles are kept in position. The screwed plug is lined internally with felt.

Total weight of the Silencer without the Barrel and Nut Barrel is approximately 1½ lbs.

The length of the Barrel is 3¾". At its muzzle end it is reduced in diameter to 9/16" for a distance of ⅛" to fit into the Barrel Bearing Plug in the Silencer. Six gas escape holes are bored equidistant around the periphery of the Barrel at a point ⅝" from the muzzle end. At approximately 1" from the breech end, four holes are bored equidistant around the periphery of the Barrel to form gas escape holes, also.

To offset the loss of recoil due to gas escape, a lightened Breech Block is fitted, the Mk. 3, and the Spring Recoil is shorter, being 8½", plus or minus 1/10".

Because of the delayed dispersal of the gases, it is recommended that single shots ONLY be fired.

During cleaning, oil must be kept out of the Silencer otherwise a fairly heavy density of smoke is emitted which obscures the sights and would give away to the enemy the position of the firer. Oil also causes accelerated fouling in the Silencer.

To assist in preventing oil entering the Silencer a special Cleaning Rod is issued, suitable for use with either the Mk. 2S or Mk. 6 Carbines.

This Silencer considerably reduces the report of the weapon and is very effective, but the Silencer becomes very hot after firing a number of rounds. To counteract this, the Silencer is bound for a distance of 6" with asbestos string covered and secured by a webbing gaiter to form a comfortable "hold" for the left hand.

DISTINGUISHING COLOURS OF PROJECTILES

TYPE OF PROJECTILE	OERLIKON — Manufactured in		
	Britain & Canada	U.S.A.	Switzerland
A.P.	—	—	—
A.P./T	Black with white tip	—	—
BALL (called Practice projectile for Oerlikon)	Greenish grey	Greenish grey	Greenish grey
H.E.	Buff	White or yellow (*)	Brown
H.E./1	Signal Red	Red or pink (*)	—
H.E./T	Light Blue	Light grey or dark blue (*)	Blue
H.E./1/T	Bright green	—	—
S.A.P./1	Red with white tip	—	—
TRACER (called Practice projectile tracer for Oerlikon)	Sago green	Greenish grey with 1/8 in yellow band.	Green
BULLETED BLANK	Unpainted. Yellow coloured leatherboard or black plastic	—	—
DRILL (Mark I)	Black	—	—
DRILL (Mark II)	Unpainted hardwood	—	—
DUMBY	—	—	—

(*) According to nature of high explosive filling.

BICYCLES

GENERAL INFORMATION

Bicycles are issued to the Service for general use and at present there are four marks in use, namely, marks 4, 4*, 5 and 5*. Marks 4 and 4* are obsolescent.

During the War of 1939—45 a number of Trade Pattern (T.P.) bicycles were issued to the Service to augment the supply of the Service patterns. These included a number of ladies' bicycles for the use of A.T.S. personnel.

The Airborne and Special Service Forces are equipped with a specialised lightened, folding pattern.

This Precis deals mainly with bicycles marks 5 and 5* but, where considered necessary, reference is made to the other types.

DIFFERENCE IN MARKS

The Mark 4

The mark 4 was introduced in 1911 and is fitted with a coaster hub and a front hand-applied pull-up lever brake.

The Mark 4*

The mark 4* was introduced in 1915 and is fitted with a freewheel hub and two hand-applied pull-up lever brakes.

Both of these bicycles are obsolescent vide L. of C. B.5107 of Sep. 1941.

The Mark 5

The mark 5 was introduced in 1940 by L. of C. B.4153 of Dec. 1940. It is fitted with a coaster hub and a front roller lever brake. Its principle is similar to the mark 4, manufacture being simplified by using a number of Trade Pattern components.

The Mark 5*

The mark 5* was introduced in 1942 vide L. of C. B.6535 of Aug. 1942. It is fitted with a freewheel hub and two roller lever brakes.

Component	Mark 4	Mark 5
Frame	Top tube 1 1/8" dia Detachable back stays	Top tube 1" dia. Brazed-up back stays
Handlebar	1" dia. bends with NO brake lugs	7/8" dia. bends with brazed-on brake lugs
Front forks	2 plate crown oval section blades	Single crown "D" section blades
Brakes	Pull-up lever	Roller lever
Front mudguard	NO front extension	With front extension.
Front and rear mudguards	Single stays. Bridges fitted outside	Double stays. Bridges fitted inside
Covers tyre	28" by 1 5/8" or 1 3/4" beaded (mark 1), wired (mark 2)	28" by 1 3/4" wired (mark 3)
Front hub	5/16" spindle without lock nuts	3/8" spindle with lock nuts
Tread	5"	5 1/2"

Trade Pattern Bicycles

Bicycles T.P. in use by the A.T.S. Front forks will be painted red.

Bicycles T.P. Tubes top will be painted red.

GENERAL DATA FOR SERVICE BICYCLES

The Registered Number of the bicycles marks 5 and 5* is stamped on the LEFT-hand side of the seat lug of the frame. That of the bicycles marks 4 and 4* is stamped on the RIGHT-hand side.

Weight

The weight of the marks 4 and 4* bicycle is 43 lbs, marks 5 and 5*, 45 lbs.

Size of Frame.—24"

This is the distance from the centre of the bottom bracket to the top of the seat lug.

Pitch of the Chain.—1/2"×3/16"

The pitch of the chain is the distance between the centres of any two links and the spacing for the teeth of the chainwheel.

The Chain Line.—1 3/4"

The chain line is the distance from the centre of the chain links to the centre of the bicycle.

The Chain

Consists of 114 links on marks 4 and 4*, 112 on marks 5 and 5*.

Wheelbase.—45"

The wheelbase is the distance between the centres of the front and rear wheels.

Size of Wheels, Tyres and Tubes.—28"×1⅝" or 1¾"

Tread.—Marks 4 and 4*, 5". Marks 5 and 5*, 5½".

The tread is the length of the bottom bracket spindle.

The Gear of a Bicycle.—67⅕"

The gear of a bicycle represents the diameter in inches that a directly driven wheel (Penny Farthing bicycle) would have to be to propel the bicycle the equivalent distance for one revolution of the pedals, and is found by the following formula:—

> The number of teeth on the bottom bracket chainwheel multiplied by the diameter of the rear wheel divided by the number of teeth on the rear wheel chainwheel. — The gear of a bicycle.

For example, on a Service bicycle, the bottom bracket chainwheel has 48 teeth, the diameter of the rear wheel is 28" and the rear wheel chainwheel has 20 teeth.

Therefore, $\frac{48\times28}{20}$ =67⅕" which is the gear of the Service bicycle.

Balls Anti-Friction

The following sizes and quantities of balls are employed in each bicycle:—

Location	Size	Quantity	Total
BICYCLES. Marks 4 and 4*			
Ballhead	⅛"	60	60
Bottom bracket	¼"	22	22
Pedals (cone end)	3/16"	9	18
Pedals (crank end)	3/16"	10	20
Hub front	3/16"	20	20
Hub back coaster (mark 4 only)	¼"	7 Cage No. 2 9 Cage No. 1 9 Cage No. 1	25
Hub back freewheel (mark 4* only)	¼"	7 Cage No. 2 9 Cage No. 1 9 Loose	25

Location	Size	Quantity	Total
BICYCLES. Marks 5 and 5*			
Ballhead	1/8"	60	60
Bottom bracket	1/4"	22	22
Pedals (cone end)	5/32"	11	22
Pedals (crank end)	5/32"	13	26
Hubs front	1/4"	18	18
Hubs coaster (mark 5 only)	1/4"	9 } Cage No. 1 9 } 7 Cage No. 2	25
Hubs back freewheel (mark 5* only)	1/4"	7 Cage No. 2 9 Cage No. 1 9 Loose	25

STRIPPING AND ASSEMBLING

Stripping

No detailed stripping and assembling sequence is considered necessary, but information concerning the major sub-assemblies follows.

1. **Ballhead and Front Wheel**

   (i) Remove the nuts and washers from the shoe lugs and remove the brake shoes.

   (ii) Slacken the nuts from the bolts adjusting.

   (iii) Slacken the nuts clip ballhead and remove the handlebars.

   (iv) Remove nuts and washers from the front hub: remove mudguard.

   (v) Remove the front wheel by forcing out the forks sufficiently with two screwdrivers to clear the shoulders of the cones; the wheel then drops clear.

   (vi) To remove the forks from the ballhead, unscrew the nuts top, remove the washer and insert a screwdriver between the top lug and the ring socket; hold the ring socket and clip together and at the same time keep the forks up to the ballhead to prevent the balls from falling out of the ring bottom. Carefully remove the forks with the balls in position.

2. **Bottom Bracket**

   (i) Remove the cotter nuts and washers, support the cranks with a metal block and drive out the cotters with a copper hammer and remove the cranks.

   (ii) Remove the pins locking with nuts.

(iii) Rotate the bicycle in the stands erecting so that its left side is uppermost and clamp in this position.
(iv) Unscrew the left cup, at the same time pressing the spindle upto keep the balls in the cup; remove the cup with the spindle and balls.
(v) Remove the cup and balls from the right side.

3. **Pedals**
(i) Remove the pins from the cranks (crank pain has left-hand thread and the crank chainwheel has right-hand screw threads).
(ii) Grip the pin by its flat in a vice and unscrew the cap, apply the thin spanner to the cone and at the ame time loosen the lock nut with the thick spanner: remove the lock nut and cone from the pin, the balls and the pin from the pedal centre.
(iii) Remove the bar nuts and tap the end plates lightly to remove them from the centres. The bars with the rubbers are now free.
(iv) Press the bar and the rubber on the end of the open jaw of a vice, then grip the plain part of the bar and remove the rubber.

4. **The Front Hub**
(i) Unscrew the adjustable cone, place the palm of the hand on the end of the body and draw the spindle outwards: at the same time shake the hub to enable the balls to drop into the hand.

5. **The Coaster Hub for Bicycles Marks 4 and 5**
(i) Remove the plain collar and adjustable cone.
(ii) Chainwheel with lock nut and No. 2 cage—Turn the chainwheel round once and draw outward.
(iii) Remove the No. 1 cage from the cup clutch.
(iv) Remove the spindle with the attachments.
(v) Strip the spindle—remove the nut clutch, grip the spindle firmly and withdraw the clutch brake with the inner split collar from the plate brake; tap the plate brake sharply on the bench to remove the lever brake.
When it is considered necessary to remove the chainwheel or to examine the inside bearing of the driving screw, grip the flats on the latter in a vice and tap the lock nut (left-hand thread) round clockwise with a punch and remove the No. 2 cage. On no account should the chainwheel be held in a vice and the wheel rim used as a lever to unscrew the lock nut.

6. **The Free Wheel Hub for Bicycles Marks 4* and 5***
(i) Remove the cone and loose balls from the left side.
(ii) Remove the right hand cone, using the spanner if necessary.
(iii) Turn the chainwheel round one turn anti-clockwise, and remove with the driving screw, lock nut and No. 2 cage.

(iv) Remove the No. 1 cage from the cup clutch.

(v) Remove the cup clutch by tapping round anti-clockwise with a punch and hammer.

(vi) Withdraw the spindle with the nut clutch and washer. To remove, the lock nut (left-hand thread) No. 2 cage and chainwheel from the driving screw hold the latter by the flats in a vice and tap the lock nut round, anticlockwise, with a punch and a hammer.

ASSEMBLING

1. **Ballhead and Front Wheel**

(i) Assemble in the reverse order of stripping.

(ii) When the forks have been removed from the ballhead, see that the correct quantity of 1/8" balls (thirty) are placed in the bottom ring of the forks and the same quantity in the clip under the ring socket at the top.

(iii) When placing the wheel into the forks, see that the adjusting cone is on the left side.

2. **Bottom Bracket**

(i) Assemble in the reverse order of stripping, but see that the cup in the right side is allowed to project about one turn out from the side of the bracket, and that it is there secured by the pin locking and nut. Care must be taken when assembling pins locking and nuts to avoid excessive tightening of the nuts which causes damage to the cups. The number of 1/4" balls in each side should be eleven. The cotters must be assembled in opposite directions on the two cranks, so that the plain end of the cotter is to the front when the pedal end of the crank to which it is fitted is upwards.

3. **Pedals**

(i) Assemble in the reverse order of stripping.

(ii) When assembling the screwed end plate to the pedal centre, see that the lubricator cover is at about 45° to a line drawn through the rubber bar centres.

(iii) When assembling the bars with rubbers to the end plates, see that one of the flat surfaces of each bar lies parallel with the tread.

(iv) Bicycles marks 4 and 4*—Ten 3/16" balls are required in the plain or crank end and nine similar balls in the screwed or outer end.
Bicycles marks 5 and 5*—Thirteen 5/32" balls are required in the plain or crank end and eleven similar balls are required in the screwed or outer end.

4. **The Front Hub**

(i) Place the spindle with the fixed cone into the body of the hub and insert ten $^{3}/_{16}$" balls into the cup (marks 4 and 4*) or nine $^{1}/_{4}$" balls (marks 5 and 5*).

(ii) Hold the spindle in position, reverse the wheel and insert a similar quantity of balls into the other cup, then screw on the adjustable cone and adjust.

5. **The Coaster Hub for Bicycles Marks 4 and 5**

(i) Before assembly coat the brake band with red mineral jelly.

(ii) Assemble in the reverse order of stripping giving special attention to the following details:—

(iii) When replacing the brake clutch on the spindle see that the stud is located in the slot in the lever.

(iv) When replacing the spindle, with its assembled details in the body of the hub, the wheel should be horizontal and the enlarged part of the hub upward.

(v) The plain side of the No. 1 cage in the cup clutch must be next to the cone.

(vi) When adjusting bearings by means of the cone on the right side, allow a slight amount of play for free operation.

6. **The Free Wheel Hub for Bicycles Marks 4* and 5***

(i) Assemble in the reverse order of stripping, giving especial attention tho the following details:—

(ii) The shoulder of the chainwheel must abut on the face of the Driving Screw.

(iii) The plain side of the No. 1. ball cage in the cup clutch must be next to the cone.

(iv) Ensure that the driving screw engages the nut clutch.

(v) See that the full complement of balls (nine $^{1}/_{4}$") is inserted in the cup on the left side and that the cone is adjusted to permit of a slight amount of play for free operation.

THE FUNCTIONING OF THE COASTER HUB

Driving Forward

The chainwheel and screw driving being locked will, with forward pressure being applied to the pedals, cause the screw driving to rotate. The nuts clutch travels along the thread of the screw driving to the right and engages the cup's clutch.

Continued pressure causes the chainwheel, screw driving, nuts clutch, and cups clutch together with the hub to be rotated as a whole in a forward direction.

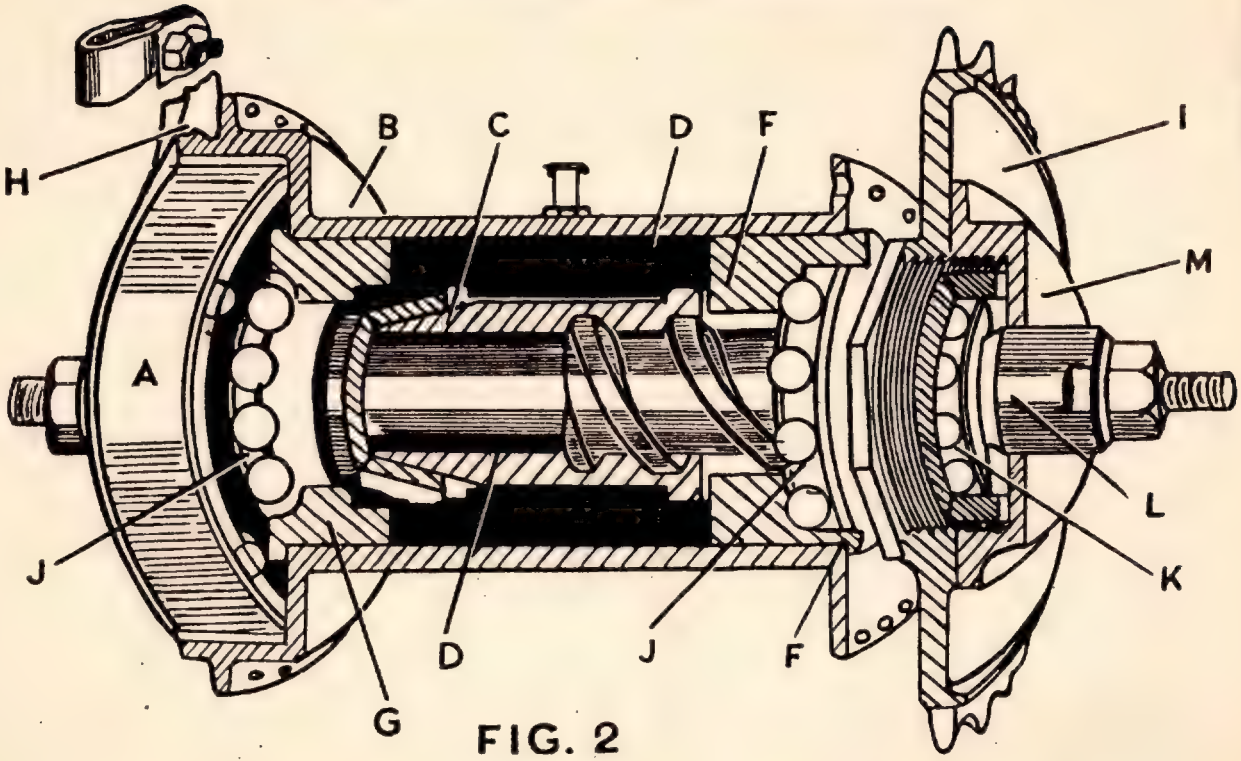


FIG. 2

Key to Figure 2. — A. Brake Band with Phosphor Bronze Ring. B. Body. C. Brake Clutch. D. Clutch Nut. E. Driving Screw. F. Clutch Cup (R. H. Thread). G. Plain Cup (L. H. Thread). H. Brake Plate. I. Chain Wheel. J. No. 1 Gauge. K. No. 2. Gauge. L. Adjustable Cone. M. Lock Nut.

Free Wheeling

When the bicycle is in motion and pedalling ceases, the chainwheel and the screw driving remain stationary so far as rotation is concerned, but the hub body, nuts clutch, and cups clutch, continue to revolve, which has the effect of unscrewing the nuts clutch from the cups clutch. In these circumstances the bicycle continues to run as a freewheel.

Braking

From the freewheeling position, when backward pressure is applied to the pedals, the nuts clutch will continue to travel to the left until it engages the clutch brake and locks itself to it.

Continued backward rotation' of the chainwheel, screw driving, nuts clutch, and clutch brake:— The latter being in engagement with the lever brake is turned on its pivot and expands the bands brake which, acting on the steel band in the hub, retards or prevents rotation of the hub and the wheel as a whole.

EXAMINATION

The bicycle should be examined methodically part by part, each component or group of components being taken in order, and particular attention paid to the points enumerated below:—

1. Check the number on the seat lug of the frame and the mark of the bicycle (mark 4, 4*, 5, 5*) with the record and history sheet. See that the Corps mark or the title of the Unit is marked on bicycles in use.
2. First, look over the bicycle generally to ensure that the bicycle is not seriously damaged, then proceed to examine in detail.
3. **Ballhead.** — Test for correct adjustment of the bearings, condition of the front forks, handlebars, including security of handles.
4. **Frame.** — Examine to see that it is free from fracture, especially at the joints.
5. **Wheels.** — Turn the bicycle upside down. Examine for true spinning, rigidity of spokes, and alignment of bearings, engagement of cones of front wheel in the forks, and the condition of the hub chainwheel. Should alignment be in error, examine for the cause which may be dished wheels, front forks or stem bent, frame twisted or bent, or chainstay tubes bent.
6. **Bottom Bracket.** — Examine for condition, alignment and the fit of the cranks, chainwheel chain and pedals; free running and adjustment of bearings and chain.
7. **Backstays.** — Examine for condition and alignment.
8. **Mudguards.** — Examine for condition and security.
9. **Front Brakes.** — Examine for condition, security of the parts, and adjustment: see that the shoes are assembled in the right direction and that the pads are not worn down too close to the shoes.

10. **Rear Brake.** — (Bicycles marks 4* and 5*) As for the front brake.
11. **Tyres.** — Examine for condition and security on the rims, and the condition of the valves.
12. **Carriers** — Examine for the correctness of pattern according to the mark of the bicycle, condition and security.
13. **Enamelling.** — Examine condition. Where chipped so as to reveal metal, the part should be painted with the Service air drying enamel after removing any rust which may be present.
14. **Lubricators.** — See that all oil holes are clear, that the lubricators are secure and that the caps, where provided, are in working order.
15. **Finally** see that the saddle, seat pillar and landlebars are well secured, that the accessories and tools are in a serviceable condition, and that the bicycle generally when found serviceable from the foregoing examination is fit and safe to ride.

Note:— Should any of the bearings give signs of undue friction or excessive play which cannot be readily adjusted, they should be stripped for examination in detail.
Special attention should be given during the examination to see that the parts are of Service pattern.

REPAIRS AND ADJUSTMENTS

1. **Chain**

(i) Cleaning. — To clean a very dirty chain, remove it from the Bicycle, soak in paraffin for a few hours, work the links about until they are quite free and clean. Hang up to drain. Then immerse in hot tallow at a simmering heat for about one hour. Wipe off the superfluous grease when cold. Too much grease on a chain causes it to gather grit.

BICYCLES MARKS 4, 4*, 5 and 5*
CHAINS (ALL MARKS)

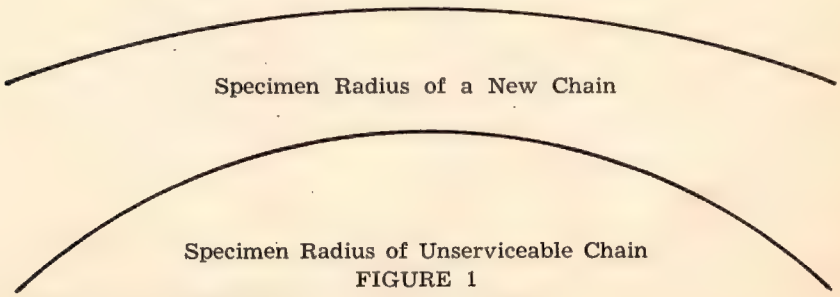


FIGURE 1
"Tests and Adjustments" — Para 1 — refers.

(ii) Test for Serviceability. — To test a chain for serviceability, lay it on a level surface, rollers uppermost, and draw the two ends round as far as they will go without tilting the chain, to form an arc. Compare this arc with that formed by a new chain and assess its serviceability.

(iii) Adjustment. — Slacken the spindle nuts and chain adjusters as necessary. Before securing the wheel by tightening the nuts, see that the hub is at right angles to the centre of the machine. This should be finally tested by revolving the wheel and observing that the rim maintains a central position between the chain stays. The chain should be adjusted so that there is a little play or back-lash between the chainwheels when the crank is moved slightly by hand. It is essential that the chainwheels should run in correct line. If the examination of the teeth shows that one side is more worn than the other, the alignment of the wheels should be attended to.

2. **Bearings**

Bearings of bicycles issued to Units from store may be found filled with mineral jelly. This must be removed and the bearings oiled before the bicycles are taken into use.

When bearings, cups, balls etc., are scored or roughened by wear, usually due to want of care in cleaning or oiling, the defective part or parts must be exchanged.

3. **Setting Frames, Front Forks, Spindles, etc.**

(i) Tubes of Frames. — When slightly bent, these can usually be set by gripping the sides of the bottom bracket beween lead clams in a strong vice, and forcing the tube or tubes in the required direction. When the bend or distortion is more serious it may be necessary in some cases to apply heat to the tube, but whenever this is done, care must be taken to avoid loosening the brazed joints.

After setting, the alignment of the top, bottom and seat tubes should be checked by means of a straight edge applied to the faces of the bottom bracket.

(ii) Chain Stays. — A distance of $4^{3}/_{4}$" should be maintained between the fork ends when setting.

(iii) Front Forks. — When setting has been carried out, alignment should be tested by two straight edges, one in the hub spindle jaws and the other across the crown. When correct the straight edges should lie parallel.

(iv) Back Stays. — To set, fix in a vice at the bridge portion.

(v) Handlebars. — These can be set by means of a suitable mandril inserted in the end of the tube, the mandril being held in the vice.

(vi) Hub Spindles and Pedal Pins. — Place between centres of the wheel truing stand or lathe and set with the copper hammer on a vice or suitable block.

(vii) Bottom Bracket Chainwheel. — When slightly bent, the wheel can be set by pressure applied when in its assembled position. When badly bent, it should be removed and set in a vice or on a suitable block.

(viii) Cranks. — Straighten on a suitable block, protecting the surfaces of the crank as necessary. As the crank is hardened (toughened) care must be taken to avoid fracture. The straight edge should be used for testing alignment.

4. **Coaster Hub**

Repair is usually limited to the replacement of damaged or excessively worn parts. Should it be necessary to fit new brake bands to the brake plate, it is desirable, in order to avoid damage to the studs in the plate, to employ a tool of the type illustrated which can be manufactured by Armourers.

5. **Inner Tubes of Tyres**

To make a fresh joint, coat the ends internally and externally over a length of about two inches with rubber solution and allow to become "tacky", then, before joining, dip the ends in mineral naphtha: this will allow the one end of the tube to slide easily into the other. After the naphtha has evaporated the joint can be made secure.

6. **Inner Tube Valves**

To refix in the tube after detachment, remove the supporting tab from the tube and pass the body of the valve into the tube. Select a new location for the valve and cut a fresh aperture which should not be larger than the screwed portion of the body; insert the body through the aperture and retain it in position by affixing another supporting tab having an aperture of similar size to that in the tube to ensure a good fit around the body. Repair the original aperture in the tube and assemble the lock nut and valve.

7. **Wheel Building**

Complete wheel building will only be carried out in R.E.M.E. Workshops, but Unit Armourers are required to remedy slightly bent rims and replace defective or missing spokes.

Whenever it is necessary to correct a bent rim, care should be taken to avoid short kinks and to first loosen those spokes which restrict the movement of the rim in the direction in which setting is required.

The usual method of setting employed is to place the wheel horizontally on a bench, support the rim where necessary on wooden blocks, and force by hand in the required direction.

(i) Hubs. — The holes in the hub flanges are countersunk alternately inside and outside.

BICYCLES MARKS 4 and 5

TOOL COASTER HUB — LOCAL MANUFACTURE

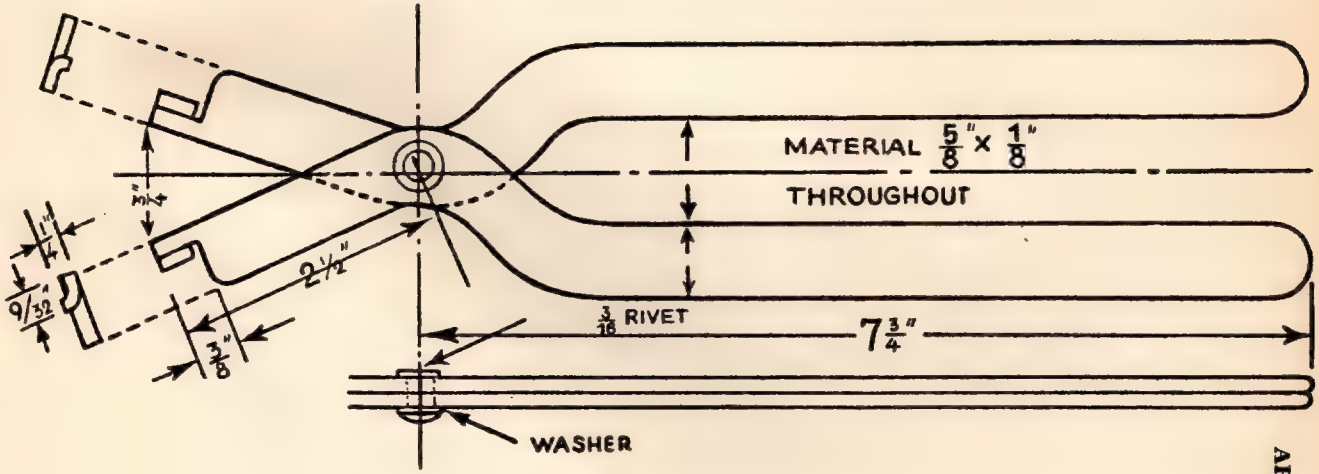


FIGURE 3

(ii) Rims. — The holes in the rims are drilled obliquely, so that the holes are directly towards the hub flanges and not towards the hub centre. As the spokes in the finished wheel proceed from the rim alternately to the right and left flanges, the rim holes are likewise arranged alternately in direction.

Under these conditions the nipples can seat correctly without causing any undue lateral strain to the rim or spokes.

(iii) Spokes. — The spokes which have their heads on the outside of the flange when the wheel is built up are called inside spokes and vice versa.

(iv) Assembling the Front Wheel. — The hubs and rims are drilled ready for use. The spokes are supplied cut to length and screwed. Lay the rim on a bench, take the hub, and, in either of the two flanges, put eight inside spokes into the eight holes which are countersunk on the outside, letting them hang loosely downwards. Now gather them up and bring them into the position shown in Fig. 4. Take one of the spokes and pass it through one of the holes in the rim which points upward, put a washer on and screw up the nipple about six turns. Now take the remaining spokes in rotation and put them into the rim at every **fourth** hole, so that between each two spokes there is **one** unoccupied hole in the flange of the hub and **three** in the rim. Place a washer and nipple on each spoke and screw all the nipples down the same distance. Now look carefully over the run to see that all spokes are in their proper places.

Next, turn the hub and rim upside down and manipulate the hub so that the spokes lie radially, or, in other words, so that any two opposite spokes are in alignment and form a diametrical line across the rim. Put a spoke in one of the holes of the top flange which are countersunk on the outside, and, without disturbing the hub and spokes already assembled, lay this spoke radially so that its outer end rests on the rim as in Fig. 5. It will be noticed that this spoke "A" lies between two others "1" and "2", and that it is immediately over a hole in the rim. Pass the spoke either to the right or left, so that it crosses the three spokes numbered 2, 3 and 4 in one direction, or 1, 8, and 7 in the other. Spoke "A" is now again between two spokes, 4 and 5 or 6 and 7, as the case may be. Place in the same relative position to these two as it was previously in relation to 1 and 2. Pass spoke "A", turning the hub if, necessary, through the hole which will be found immediately underneath it or opposite it, and secure it with a washer and nipple. Assemble the remaining seven inside spokes, missing one hole in the flange and one in the rim. Look over the wheel and see that the same relation between the spokes is

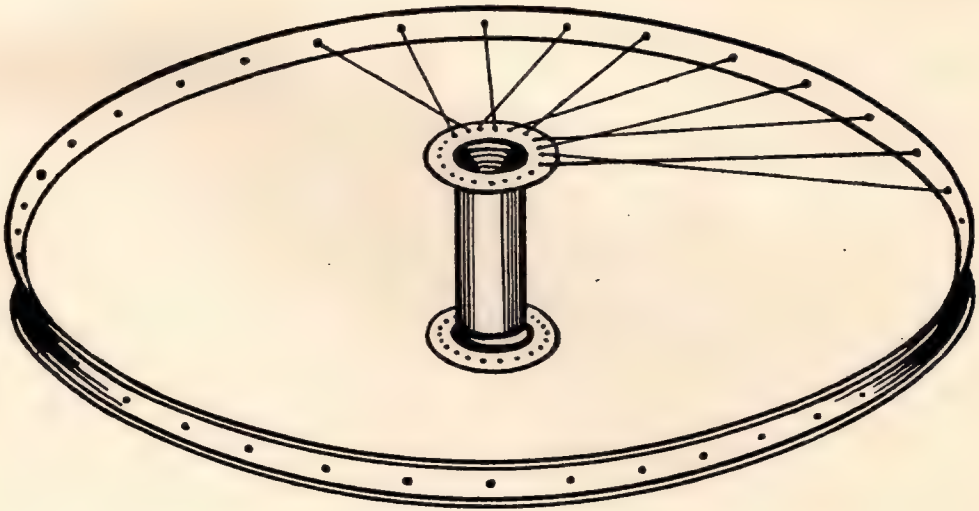
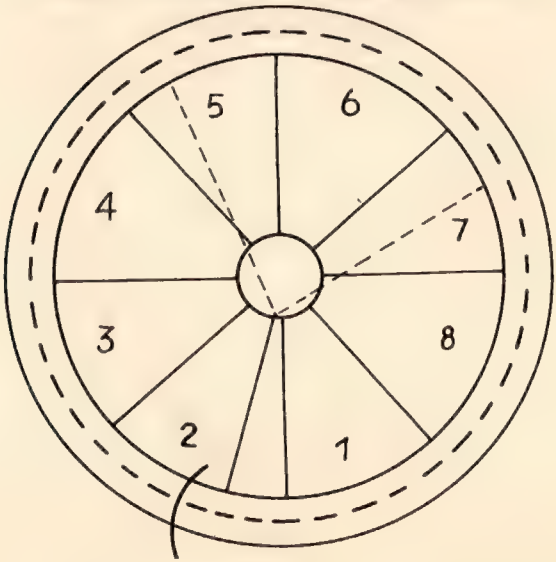


FIGURE 4

maintained throughout, and that the nipples are all screwed down the same distance. Now deal with the outside spokes. These can all be put in the flange before the lacing is begun or they can be put in and laced one at a time, whichever is the more convenient. They must be passed through the flange from the opposite side of the wheel and brought up outside. Before trying to put the spoke in the rim see that the head of it is in the right position against the inside of the flange.

Lay the spoke midway between those on either side of it in its own flange. If the wheel is now held vertically and looked at from the side, it will be seen that all the spokes in this flange are tangential in one direction of rotation, whereas those in the opposite flange are tangential in the opposite direction. Take the outside spoke, now being dealt with, and pass it over three spokes, so that it is in the same direction of rotation as the spokes in the opposite flange. It will now be found that it is in the proximity of two unoccupied holes, and bearing in mind that adjacent spokes on the rim proceed to opposite

BICYCLES MARKS 4, 4*, 5 and 5*
WHEEL BUILDING — WHEELS FRONT



Spoke "A"

FIGURE 5

flanges, it will be easy to determine which is the correct hole of these two. As a check it should be noted that the rim hole points in the correct direction. The remaining outside spokes in this flange can now be correctly positioned and secured. The wheel must now be turned over again, and the same system followed out for the outside spokes in the other flange. If the crossing of three is kept in mind it will be almost impossible to lace these wrongly.

All the nipples can now be screwed home a proportionate distance until a slight tension is perceptible on the spokes, after which the wheel can be put on the truing stand and finished, care being taken that it is kept central and true and that the spokes are properly tensioned.

(v) Assembling the Rear Wheel. — For both the hub back coaster and the hub back free wheel, the foregoing instructions with the following exceptions equally apply.

There are ten inside and ten outside spokes to each flange whereas in the front wheel there are only eight; this necessitates the crossing of **four** spokes in each case instead of three.

The Coaster Hub. — The holes for the spoke heads in the right flange are on a circle of smaller diameter than those on the left, and, in addition, each pair of holes is joined by a slot enlarged in the centre so as to admit of the spoke head being passed through. In the finished wheel the heads of one inside and one outside spoke will rest at opposite ends of the opening formed by each pair of holes and their connecting slot.

First assemble the ten inside spokes in the left flange as in the plain hub. Now put the outside spokes in the same flange, commencing with one spoke passed through the flange from the inside of the hub: cross it over **four** and put it in the middle one of the three unoccupied holes in the rim. Proceed in the same way with the other nine outside spokes. Screw home all the nipples so as to bring the flange roughly in the same plane as the rim.

The object is to ensure that when the spokes are being put in the right flange they are brought slightly under tension with a few turns of the nipples, as otherwise they would be continually falling out while the lacing was being done. Now place the wheel with the left flange and assembled spokes downwards.

Select any two of these spokes which are in alignment with or in prolongation of one another, and mark the left flange at the position of their heads.

Note the slot and the pair of holes in the right flange situated between these two marks and place the head of an inside spoke therein in position. Being an inside spoke its direction of rotation is the same

as that of the outside spokes in the opposite flange, from which it in which direction the spoke must be turned. Place this spoke at right-angles to the two spokes in the left flange selected earlier. It will be found that its screwed end is over an unoccupied hole. The spoke must be turned and secured in the **fourth** unoccupied hole from this. Position and secure the remaining inside spokes. The outside spokes can now be put in, remembering that their heads must be inside, and that each outside spoke must cross **four** of the inside spokes in the same flange. The wheel must then be finished in the truing stand.

8. **Wheel Truing**

After being built and subsequently as occasion demands it, a wheel needs "truing" i.e. the hub must be exactly in the centre of the rim at all points and the spokes must all be of equal and correct tension to maintain the wheel in a true condition.

Truing is carried out in a stands wheel erecting, commonly known as a "truing stand"; when a stands wheel erecting is not available, the wheel may be trued assembled to the forks, but this method is not entirely satisfactory. Before making any adjustment to the nipples, remove the outer cover and inner tube if fitted, otherwise a protruding spoke end is liable to penetrate the tube and cause a puncture.

The three errors to be found in a wheel are:—"Dish", "jump", and side error".

(i) Dish is the distance from the centre of the hub to the outside of the rim, measured by the "gauge bicycle" from the outside of the flange on the hub to the outside of the rim. The dish should be equal on both sides and is measured by applying the gauge to the rim and adjusting the pointer in the centre of the gauge until it just touches the flange on the hub. With this reading set, apply the gauge on the opposite side of the rim and note the difference. It should be equal.
To adjust, slaken off an equal amount all the spokes on the side with the least dish, and tighten all the spokes on the opposite side an equal amount until the dish is equal.

(ii) Jump is the eccentricity of the rim in relation to the centre of the Hub, and should be non-existent.
To adjust, slaken the spokes at the narrowest radius and tighten an equal amount those diametrically opposite until the wheel spins without any eccentricity.

(iii) Side error is the amount of error in the relationship between the rim and the hub—as opposed to jump—and is closely related to dish. To adjust, slacken off the spokes on the negative side and tighten those opposite an equal amount until all side error is eliminated.

The tension of the spokes is important in order to maintain the wheel in a true condition and to prolong the life of the nipples. All spokes should be of equal tension, firmly held in position by the nipples which should still allow of a small adjustment.
After truing the wheel, carefully file off all protruding ends of spokes before securing the tape.

STOVE ENAMELLING BICYCLES

(a) Strip the bicycle completely, including the wheels.
(b) With the aid of a blowlamp, burn off all the old enamel, taking care not to get the components too hot.
(c) Spokes, nipples and bearings will on no account be heated, but will be cleaned off by using scratch card of emery cloth very carefully.
(d) Before commencing to enamel ensure that the enamelling room and stove are free from rust.
(e) Warm up the enamelling room by lighting the oven burners and leaving the oven doors open to get the room temperature to 65° F.
(f) Coat the components with anti-rust paint and hang them up in the oven, taking care that they do not touch. Close the doors gently and bring the temperature up to 250° F. and bake for half an hour.
(g) Turn out or lower the gas jets, remove the components from the oven and allow to cool down.
(h) Coat with Dead Black Paint and replace in the oven, bringing the temperature up to between 250°—300° F. and bake for 1½ hours.
(i) Remove from the oven and when cool, examine for any rough or bad patches, smooth down as necessary and wipe with a clean, smooth rag.
(j) Apply Service Green Enamel evenly, laying the brush strokes lengthwise where possible.
(k) Place in the oven carefully and bring the temperature down to 180° F. and bake for four hours.
(l) Care must be taken not to raise the temperature above 180° F., as this will tend to take out the colouring.
(m) Before assembling the bicycle remove any enamel which may have found its way on to any bearing surfaces such as holes for spindles in cranks, cotters, etc.
(n) Oil any parts that have not been enamelled, such as inside the bottom bracket, sear tube, stem front forks, etc. Check up components, clean all bearings, cones etc. and assemble the bicycle.

NOTE: While one coat each of Anti-rust and Dead Black is sufficient, two coats of Service Green are required.
is easy to determine at which end of the slot the head must lie, and

LISTS OF CHANGES

L. of C.	Date	Detail	Remarks
B. 2461	May 1939	Tools chain bicycle T. P. Clamps bicycle (for chain)	Introduction Obsolescent
B. 2658	Aug. 1939	Bags Armourers bicycle Mark 2, empty	New pattern
		Bags Armourers bicycle Mark 1, empty	Obsolescent
		Bags Armourers bicycle filled	Filling modified
B. 2639	Aug. 1939	Pumps bicycle T.P.	New pattern Provision of spares
B. 4153	Dec. 1940	**Bicycles Mark 5, complete** **Coaster Hub**	Introduction
B. 5102	Sep. 1941	Vocab. Section C.3	Revision
B. 5107	Sep. 1941	Bells bicycle O.P. Bicycles Marks 4*A, 4*B. Carriers kit rear Marks 2 and 3 Lamps bicycle front O.P. Pumps bicycle O.P.	Provision of spares
		Bicycles Marks 4A and 4B	Obsolescent
B. 5633	Feb. 1942	Bicycles Mark 5 Joints slotted pull rod	Nomenclature
B. 6533	Aug. 1942	Bicycles Marks 5 and 5* Components	Introduction
		Dies spoke Holders die spoke	Revision of C 3
B. 6534	Aug. 1942	Bicycles Marks 5 and 5* Components Boxes Armourers spares	Introduction
B. 6535	Aug. 1942	**Bicycles Mark 5*** **Freewheel hub rear**	Introduction
B. 6714	Sep. 1942	Bags Armourers bicycles Mark 2, empty	Introduction
B. 6715	Sep. 1942	Bicycles Mark 5	Modification to rings top and bottom ballhead to take 1/4" instead of 3/16" balls
B. 6716	Sep. 1942	Bicycles Mark 5 Nuts ballhead clip	Introduction

FLAME THROWER PORTABLE No. 5 Mark 1

GENERAL.

EFFECTS

1. Flame is lethal, but its principal effect is morale. Human beings are usually afraid of fire and soldiers are no exception. It has been found that when flame is used in an attack the enemy will not stand up to it; they either crouch in their positions, run or surrender. In many cases the sight of flame approaching or being used on nearby positions will achieve these effects. These effects on morale are even more marked when surprise in the use of flame has been achieved. However, once the flame has passed or died down determined troops recover quickly. Thus they must be engaged immediately by following up infantry.

2. In addition to its considerable psychological effect, flame is a highly lethal weapon. Troops who are caught in open defences and saturated with flame are almost certain to be killed by burning or shock; those caught in pill-boxes that are smothered in flame may be asphyxiated.

3. Besides those of the enemy who are demoralized or severely burned by the flame, a number are often neutralized in the following ways:—
   (a) A blob of flame on a man requires immediate attention, during which time he is unable to take offensive action.
   (b) When their position takes fire or has burning fuel in it, the enemy is forced to leave it and is neutralized until he can take up an alternative position.
   (c) The enemy is neutralized through fear while waiting to see if he is to be a target for the flame.
   (d) Enemy positions are often neutralized by the blinding effect of the flame and the smoke that accompanies it.

PERFORMANCE OF FLAME.

4. Present operational fuels give a long rod-like jet of burning fuel that breaks up towards the end of its flight or on striking an object, scattering burning blobs, which adhere to whatever they hit, continue to burn for several minutes and are very difficult to extinguish. Flame fuel can be ricochetted to splash into pill-boxes, weapon pits, etc. Thus it has a searching power that enables enemy troops to be hit in positions inaccessible to other forms of fire. Care must be taken in wooded country of this splashing characteristic or our own troops may be injured.

5. In addition to ricochetting flame into the apertures, enclosed defences can be smothered with fuel, which will stick to them and continue to burn. The flame will then produce intolerable heat and smoke, and may asphyxiate the defenders.

6. Since the fuel sticks to whatever it hits and continues to burn, it will set fire to dry woods, buildings, and field fortifications containing timber, such as bunkers. If the fuel falls on damp objects, the flame will die out when the fuel has been consumed. The incendiary value is only considerable when the flame is playing on inflammable materials as in damaged buildings or on dry vegetation.

7. Thick foliage, such as hedges and the undergrowth in woods, is not readily penetrated by the operational type of fuel. This handicap can be partially overcome by the use of ordinary diesel engine oil which gives a scorching non-persistent flame more capable of penetrating dense growth. Such fuels have considerably less range, do not burn on the target, and are not in normal supply, and their use is not generally recommended.

8. It is possible, by cutting out the ignition system, to fire unignited or "wet" shots, which can be subsequently ignited on the target by a burning shot. The range of a "wet" shot is considerably less than that of an ignited one.

9. Flame fuel will burn on water.

10. The flame is dangerous while in the air, but once it has landed men can walk though it, avoiding puddles, without harm, and assault boats can pass unscathed through it whilst it is burning on the surface of water.

RANGE.

11. The range of a flame-thrower varies, depending on certain factors. The range that can consistently obtained by any given weapon is known as the "maximum effective range", which is the distance from the nozzle of the gun to the centre of the main bulk of burning fuel on the ground. Maximum ranges, of course, especially with a following wind, are considerably greater than this, but with a correspondingly greater dispersion of the flame. Head and side winds reduce range, and the latter also affect accuracy. To secure accuracy against pin-point targets, such as loopholes, flame-throwers should be used at shorter ranges than the "maximum effective range".

FUEL CAPACITY.

12. The fuel capacity of flame-throwers is limited and fuel must be used economically and to the best advantage. The weapon should not be used too liberally during the approach, the bulk of the fuel being retained for use on the main target area. Once this fuel is exhausted the flame-

thrower must come out of battle to refuel, unless carried in a tank or carrier that is to be used in the same operation in its normal role. To ensure a continuity of flame, they should be used in numbers, leap-frogging each other through the enemy positions.

SMOKE EFFECT.

13. Normal flame fuel produces a fairly dense smoke which at times tends to screen the target, but if used against damp targets considerable smoke may be produced.

PRINCIPLES.

1. From a consideration of the general characteristics of flame certain principles in its use can be deduced:—

   (a) The effect of flame is largely morale. It should therefore:—

      (i) Be used in mass whenever possible.

      (ii) Be employed only when essential, so as not to let the enemy become used to it.

      (iii) Be immediately followed up by infantry who should move on to the position the moment the flame-thrower stops flaming.

   (b) Once flame has landed it is not dangerous to the troops following up; it is therefore the ideal weapon for neutralizing the enemy for the last 100 yards up to his position when other forms of fire support have to stop.

   (c) It is a short range weapon; therefore flame-throwers require fire support and smoke to enable them to get within range.

   (d) A flame-throwers fuel capacity is limited; therefore it must be used on specific targets suited to its capabilities.

FLAME' THROWER PORTABLE No. 5 Mk. I.
CHARACTERISTICS.

1. This EQUIPMENT, designed *not to exceed 50 lb. in weight* when filled and charged, is manufactured from light weight materials. It is a one-man weapon with an *EFFECTIVE RANGE of about 50 yards.*

2. The *DURATION OF FIRE* of the equipment *is about 10 SECONDS.* It may be fired intermittently or continuously. Experience, however, shows that *SINGLE SHOTS OF 2 SECONDS DURATION* (the burning time of an igniter) give the best results.

3. The *CARRYING EQUIPMENT*, consisting of a belt and two braces, is capable of easy and quick adjustment to the firer.

4. *IGNITION* is obtained by the burning of a magnesium-filled igniter and is timed to occur *BEFORE* the pintle valve is opened to release the fuel under pressure

   The ignition and firing systems consist of an igniter, trigger, trigger bar and firing pin.

5. The *GAS CONTAINER* is charged with *INERT GAS* at 2.000 lb. per sq. inch.

6. The *WORKING PRESSURE* of 200 lb. per sq. inch is obtained through a disphragm-operated pressure control valve fitted in the fuel container, which becomes operative when the gas container is fitted and the valve turned to the "ON" Position.

7. The *PRESSURE SYSTEM* is the driving force necessary to expel the fuel from the container, along the fuel hose and out through the projector nozzle. Two operations are necessary to project a stream of burning fuel:—

   (a) The projection of the fuel by a combination of a pressure and fuel system.

   (b) The ignition of the fuel.

   The pressure system consists of a gas container and a pressure control valve. The Fuel system comprises a fuel container, fuel hose, barrel, and pintle valve assembly, the pintle valve being operated by a valve lever and control cable when the trigger is pressed.

8. *UNIGNITED SHOTS* may be projected as required by depressing a spring-loaded pin in the left side of the casing. This actuates as firing pin stop to prevent the final forward movement of the firing pin.

9. *A SAFETY DEVICE* is fitted to prevent movement of the trigger and consequently the trigger bar and firing pin.

SHIPPING AND ASSEMBLING F.T. No. 5

TO STRIP THE PRESSURE CONTROL VALVE.

(a) Remove the body cover, using the No. 1112 spanner.

(b) Lift off the control valve adjusting cap.

(c) With the No. 1112 spanner, remove the body end screw.

(d) Insert the No. 32 Key and unscrew the mainspring adjusting screw to ease the pressure off the mainspring.

(e) Using the No. 1112 spanner, unscrew the body from the pressure valve housing.

(f) Remove the diaphragm seating washer from the pressure valve housing.

(g) With the No. 1113 spanner, remove the pressure valve seating securing bush from the pressure valve housing. The pressure valve, spring seat, spring and filter can now be removed.

NOTE:— Care is to be taken not to damage the filter when removing it.

(h) Using the screwdriver end of the No. 1112 spanner, unscrew and remove the gas container seal retainer.

(i) Remove the gas container seal.

(j) With the No. 1114 spanner, remove the nipple.

(k) Remove the external seal from the pressure valve housing.

(l) Tap out the diaphragm, mainspring and mainspring seating washer.

(m) Lift the body washer from its locating pin.

(n) Withdraw the control valve.

(o) Using the No. 32 Key, unscrew the mainspring adjusting screw and remove.

(p) Remove the relief valve liner bush together with the relief valve spring adjusting screw.

(q) Remove the relief valve spring, also the liner with valve. Ensure that the seal is removed.

(r) Remove the upper centre and lower seals from the body.

NOTE:— Before removing the centre seal, withdraw the spreader which is in two parts, from inside seal.

TO ASSEMBLE THE PRESSURE CONTROL VALVE.

Before assembling is commenced, examine all parts, especially the seals to see that they are free from cuts and are perfect in shape.

(a) Replace the upper body seal with the lips falling downwards. Ensure that the inner portion is located in its groove and that the seal freely moves when correctly seated.

(b) Replace the centre seal with the lips facing UPWARDS. **This is most important.** Make sure that it is correctly seated and is free to move. Replace the spreader.

NOTE:— This seal differs slightly in shape to the upper and lower seals.

(c) With the No. 32 Key, replace the mainspring adjusting screw.

(d) Having massaged the relief valve seal in warm lanoline of buffer oil, squeeze it gently and insert it with the lips facing downwards, through the $^{5}/_{16}$-in hole at the bottom. Place the relief valve liner in position and insert a pencil or similar article into the liner and carefully pass it through the seal, thus forcing the lips of the latter into position.

Withdraw the pencil and insert the relief valve, spigot foremost, and the relief valve spring. Next screw the bush, securing the liner into position and also the relief valve spring adjusting screw.

(e) Remove the retaining nut and seal, place the control valve in position. Reave the seal lips downward over the thread followed by the retaining nut. Tighten the latter until the drag of the seal can be felt.

(f) Replace the body washer on its locating pin with the throw of the eccentric facing the control valve. Replace the body end screw.

(g) Invert the body. Insert the mainspring seating washer with its bevelled portion facing downwards. Replace the mainsping and diaphragm.

(h) Invert the pressure valve housing. Screw in the nipple and tighten with the No. 1114 spanner.

(i) Replace the gas container seal with its lips facing downwards. Screws home the retainer, using the screwdriver end of the No. 1112 spanner.

(j) Turn the pressure valve housing the correct way up. Replace the external seal with the lips facing upwards and see that it is correctly located in the groove.

(k) Examine the filter and replace it. See that it is correctly seated.

(l) Insert the pressure valve spring and the spring seat, the dome of the late facing the spring.

(m) Insert the pressure valve seat in the securing bush, then the pressure valve. To facilitate this, place the pressure valve housing in an adaptor to be provided locally or use the gas inlet adaptor of the testing gear if available.

TO STRIP THE PROJECTOR.

(a) Depress the cylinder retaining lever and remove the igniter cylinder.

(b) Remove the five screws securing the casing, depress the cylinder retaining lever and withdraw the casing.

(c) Loosen screw plae guide rod, disengage plate from rod and remove rod guide trigger bar.

(d) Remove the split pin from the trigger bar pivot pin and washer and push the pivot pin out. Release the peg on the front end of the trigger bar from the cylinder positioning cam, unhook the trigger bar spring and remove it. Remove the trigger bar.

(e) Ease the grub screw retaining the trigger pivot pin and push out the trigger pivot pin. Remove the trigger.

(f) Remove the screw securing the part 2 trigger to the part 1. Remove the connector to valve lever link connecting pin. This releases the valve lever with the connecting link.

(g) Remove the four nut securing the part 1 trigger to the hose connection. Remove the hose connection joint, taking care not to damage it.

(h) Manipulate the rear end of the control cable when the hose connection seal will become accessible and can be removed.

(i) Tap out the control cable gland.

(j) Place the projector in a vice, remove the outer nozzle and front sleeve, then remove the projector from the vice.

(k) Depress the cylinder retaining lever and remove the positioning cam.

(l) Slacken off the nut on the rear flange of the centre sleeve and withdraw the latter from the barrel.

(m) Remove the nut securing the firing pin stop axis pin. The stop, axis pin and cylinder retaining lever spring can now be removed.

(n) Remove te split pin and washer from the cylinder retaining lever pivot pin, remove the pivot pin and lever.

(o) Remove the firing pin guide bracket nuts and bolts, when the guide bracket, shim and firing pin complete can be removed from the centre sleeve. Remove tubes stiffening centre sleeve.

(p) Remove the lock nut and adjusting nut, then the firing pin return spring. Remove plate guide triggerbar, bracket guide firing and plate packing.

(q) Remove the safety catch sleeve from the barrel and guide casing.

(r) Remove the nuts securing the barrel to the hose connection.

(s) Ease the grub screw retaining the front nipple to the rear connecting rod of the pintle valve, remove grub screw on control cable and disconnect the control cable. Remove the rear guide and pintle valve spring.

(t) Ease the grub screw securing the pintle connecting rod and the intermediate rod, when the pintle and front guide can be removed.

(u) Remove the screw retaining the cable guide, then the guide. Withdraw the control cable to the rear.

TO ASSEMBLE THE PROJECTOR

The assembly of the projector may be carried out in the reverse order to stripping, and when doing it, observe the following points:—

(a) When replacing the centre sleeve, allow sufficient space for the safety catch sleeve to be rotated on the barrel.

(b) When assembling the centre sleeve, see that it is correctly located by slipping on the casing and positioning it, so that the cylindr retaining lever coincides with the slot in the casing.

(c) When assembling the firing pin, the return spring should be adjusted so that after firing the point of the pin is withdraw clear of the igniter. To do this, replace the positioning cam and the igniter cylinder and leave a fired igniter in the chamber. Pull the trigger as for firing. Release the trigger, when the point of the firing pin should withdraw 0.03125 of an inch from the base of the igniter.

(d) The valve lever adjusting screw should be set so that the last motion of pulling the trigger gives sufficient pull on the control cable to completely withdraw the pintle valve the movement of which is 0.03125 of an inch minimum.

ACTION OF THE PRESSURE CONTROL VALVE

When the gas container is screwed on to the fuel container the Schrader valve in the former is opened automatically. Gas enters the pressure valve chamber at 2,000 lb per sq in through the nipple and filter. The pressure valve is open. The adjusting cap on the body is turned to "ON" which opens the control valve. Gas passes through the pressure valve, through the four ports in the valve seat scuring bush on to the diaphragm. When the pressure "buildup" below the diaphragm is greater than the mainspring preesure, i.e., about 200 lb. per sq in. the diaphragm is forced up to close the pressure valve, the latter being kept closed by its spring.

The gas passes through the 12 Ports in the pressure valve housing into the fuel container tube. The control valve being open, pressure passes the valve head, through the port in the valve chamber and past the centre pack seal into the fuel container. Any escape of gas is prevented by the upper and centre seals. As the pressure is expended, the spring pressure on the diaphragm exceeds the gas pressure below it, therefore the diaphragm flexes downwards and opens the pressure valve to allow a fresh intake of gas to build-up until the diaphragm rises and shuts the valve.

This process is automatic while firing.

Any pressure in the low pressure system in excess of 240 lb. per sq. in. forces the relief valve off its seat, compresses its spring and enters the ports to escape upwards and to atmosphere. When the pressure is adjusted, the spring re-asserts itself and forces the valve to its seat.

On turning the control valve adjusting cap to the OFF position, the narrowest portion of the cam is brought coincident with the stem of the control valve. The latter now moves up and closes under gas pressure which is held by the seal on the valve head.

ACTION OF THE PROJECTOR ON FIRING

Assuming the gas container and igniter cylinder to be fitted.

To Fire:—

(a) Turn the safety catch sleeve to FIRE.

(b) On pressing the trigger, the trigger bar is pulled to the rear, extending the trigger bar spring until the trigger bar catch engages the firing pin. The latter is then withdrawn to the rear, compressing the firing pin spring. The trigger bar catch is tripped by the toe on the firing pin guide bracket. The firing pin, under the action of its spring reasserting itself, is forced forward until the cap of the igniter is struck. This is the IGNITION PHASE of the firing.

The firing pin return spring withdraws the point of the firing pin from the base of the igniter and subsequently allows the igniter cylinder to be rotated. Further pressure of the trigger engages the valve lever, pivots it to the rear and pulls the control cable. This withdraws the pintle from its seat and compresses the pintle valve spring. The fuel under pressure is ejected and ignited by the burning igniter.

When the trigger is released, the pintle valve spring reasserts itself and forces the pintle on to its seat to cut off the fuel. At the same time the trigger bar moves forward under the action of its spring reasserting itself. The peg on the front of the trigger bar riding in the cam grooves of the positioning cam, rotates the latter 36 degrees clockwise to bring the next cartridge coincident with the firing pin.

TO Fire an UNIGNITED SHOT

Depress the spring-loaded pin on the left side of the casing. This causes the firing pin stop to engage the firing pin and prevent its final forward movement. When the trigger is pressed, the trigger bar and firing pin are actuated in the normal way, except that on tripping, the firing pin is prevented from striking the igniter, therefore there is no flash. The valve lever is actuated, the pintle valve opened and the fuel ejected.

On releasing the trigger, the pintle valve closes under the action of its spring. When the spring-loaded pin in the casing is released, the firing pin stop is disengaged from the firing pin, which then moves forward to its normal position.

MISS — FIRES

(a) The trigger is not fully released after firing a shot. This prevents the trigger bar from resuming its normal position and consequently the igniter cylinder is not fully rotated, with the result that a fired igniter is again struck, or an igniter is not coincident with the firing pin.

(b) If the trigger is fully released and a missfire occurs it may be due to a faulty igniter. In this case, the trigger should be pulled again after first fully releasing it. This brings a fresh igniter into position. If missfires are persistent, examine projector for friction bearing surfaces. Ensure that firing pin stop does not foul firing pin.

F.T. No. 5 Mk. 1 — TOOLS and EQUIPMENT

CASES TRANSIT

No. 25.	—	For One Equipment — Fuel tank and Projector	—	85.5 lbs.
No. 26.	—	10 Gas Containers in individual cases	—	140.0 lbs.
No. 26.	—	One Gas Container Case	—	7.5 lbs.
No. 29.	—	Case Gas Container Testing Apparatus	—	132.0 lbs.

TOOLS COMBINATION Mk. 1.

The tool consists of five parts that are necessary for stripping, assembling and adjusting certain components of the equipment. They are a No. 1112 spanner, No. 1113 spanner, No. 1114 spanner, No. 32 key, and a seal inserting tool.

The Mk. 1. No. 1112 spanner is fitted with three pairs of pins at one end; one pair to suit the pressure control valve body and the others for inserting and removing the body end screw and body end cover. The opposite end of the spanner is prepared as a screwdriver for inserting and removing the gas container seal retainer. A split ring secured to the spanner provides the means of attaching the other components of the tool.

The Mk. 1. No. 1113 spanner has a two-dimensioned head, the larger for inserting and removing the pressure valve seating securing bush and the other for the Schrader valve in the gas container.

The Mk. 1. No. 1114 spanner is used when inserting and removing the pressure valve nipple.

The Mk. 1. No. 32 Key — is used for moving the mainspring adjusting screw when correcting the tension on the mainspring.

TESTS AND ADJUSTMENTS F.T. No. 5. Mk. 1.

All tests to be carried out in SECOND, THIRD AND FOURTH LINE W/SHOPS are to be found in E.M.E.R. ARMAMENT V 654 Issue I, 10 Nov 1945.

All Equipment necessary for the above tests is to be found in the Case Transit No. 29 which also includes equipment necessary for the replacement of fuel hoses.

The only replacement permitted in FIRST LINE is the fitting of Fuel Hose Elbow Seals when they become unserviceable, three seals are issued in the Case Transit No. 25 with the equipment.

6125/APSS/9.51/300

6125/APSS/9.51/600